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The PROGRESSIVE FISH-CULTURIST

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FISH AND WILDLIFE SERVICE

THE PROGRESSIVE FISH-CULTURIST

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(See inside back cover)

The PROGRESSIVE FISH-CULTURIST

News and Views from many Sources on Practical Hatchery Problems

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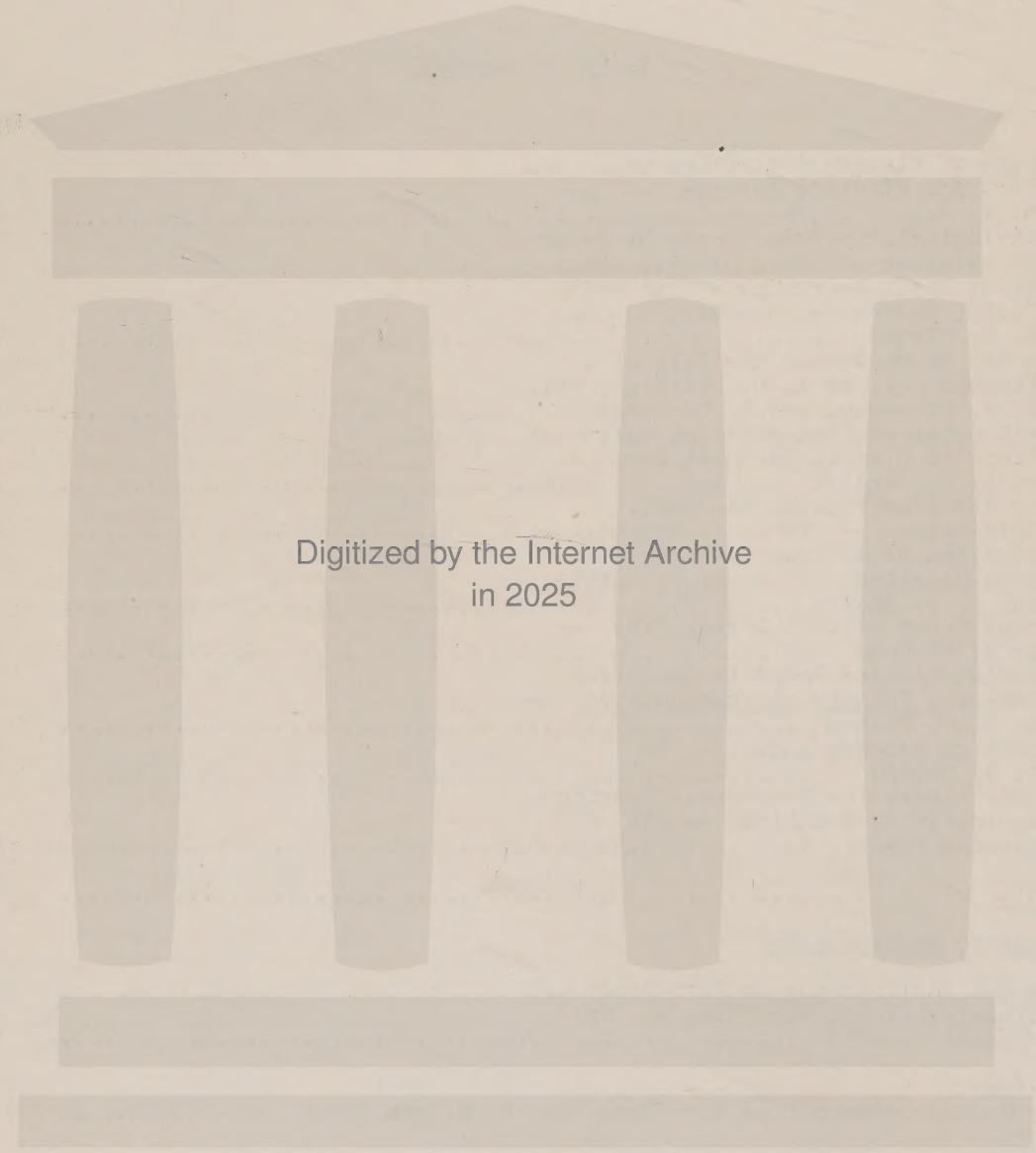

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TEN YEARS OF FISHERY ACTIVITIES UNDER THE FISH AND WILDLIFE SERVICE

Albert M. Day, Director
U. S. Fish and Wildlife Service
Washington, D. C.

Address at the 43d Annual Convention of the National Canners Association, Atlantic City, New Jersey, January 28, 1950

IT IS HARDLY proper for me as Director of the Fish and Wildlife Service, one of the agencies that is proposed for reorganization by the Hoover Commission, to discuss whether that Commission's recommendations are sound and should be adopted. Rather, I prefer to make some general observations about the background of the Hoover Commission Report on this particular subject and explain what the Fish and Wildlife Service is attempting to do to aid in the broad development and utilization of the highly important fishery resources of this Nation.

In the first instance, it should be well understood that the final recommendations of the Hoover Commission resulted only after a great deal of conflicting and diverse testimony on this important subject had been given careful consideration. The whole problem is complex because fishery management is complex. It must always be woven into the intricate patterns of land and water uses and human needs in our expanding civilization. This fact is well emphasized when we recognize that the three different task forces studying the organization of the government came out with three different recommendations when it came to fish and wildlife matters.

The report of one committee would have dispersed the conservation agencies through the government and would have put the Fish and Wildlife Service in a Public Works Department. The Agricultural Committee recommended a transfer to Agriculture of all major public land administration activities and functions including the Fish and Wildlife Service. The task force on Natural Resources proposed to abolish the Interior Department and create in its place a Department of Natural Resources, among which would have been a division of the present Fish and Wildlife Service into a Fisheries Service and a Wildlife Service, each separately administered. The final recommendations of the entire Commission were that only the commercial fisheries activities of the Service should be transferred to the Department of Commerce. As evidence of the diversity of opinion among the members of the Commission, it should be noted that dissents to this proposal were expressed by Vice-Chairman Dean Acheson and Commissioners James Forrestal, James K. Pollack, and James H. Rowe, Jr.

With this divergence of opinion among the members of the Hoover Commission and the various task forces as to the proper place in government for the Federal responsibility for fishery activities, it is not surprising that the resultant reactions of the public also have been mixed. The American Fisheries Society, organized in 1872 and now the oldest scientific biological organization in the United States, at a meeting in Winnipeg, Canada, last September, passed a resolution endorsing the task force recommendations of the Report on Natural Resources,

with the exception that the Society opposed that portion of the report which recommends the separation of fisheries administration from wildlife administration.

Likewise, a meeting of the International Association of Game, Fish, and Conservation Commissioners, also meeting in Winnipeg, in September, passed a resolution endorsing the general purposes of the Natural Resources task force report, but also stated that they opposed the recommendation of the report which would separate fisheries from wildlife in the present Fish and Wildlife Service. Within the past few weeks, the Executive Officers and the Legislative Committee of the International Association again reaffirmed to Secretary Chapman their strong opposition to this proposal. The International Association is made up of representatives of all of the State conservation departments in the country, the great bulk of which administers both fisheries and wildlife in a single organization of the State. In fact, of the 48 States, only 8 have separate departments devoted to commercial fisheries. In the other 40, commercial and sport fishery and wildlife management activities are all in the same department. The same, of course, is true in Alaska.

To the contrary, the Pacific Fisheries Conference, composed largely of members of industry operating on the West Coast and in Alaska, by action taken at a recent meeting in California, adopted the following resolution, and I quote:

> "Whereas, the consolidation by Executive Order of the former Bureau of Fisheries and the former Bureau of Biological Survey into one Bureau in the Department of the Interior, called the Fish and Wildlife Service, has been demonstrated as unsound, illogical and ineffective, and has not served to further the sound, efficient administration of fisheries, and whereas the Commission for the reorganization of the Executive Branch of the Government, commonly referred to as the Hoover Commission, recommended that the administration of fisheries should be separated from the administration of wildlife:
>
> Now, Therefore,
>
> "Be it resolved, that the Conference heartily endorses the recommendation that such separation should be made and also urges that the reestablished Division of Fisheries should be transferred in toto to the Department of Commerce or to a new Department of Natural Resources if such a Department should be created and now, in whichever Department placed, fisheries should be under direct charge of an officer of the rank of Assistant Secretary."

It is to the assertion of the Pacific Fisheries Conference that the present organization has been demonstrated as "unsound, illogical, ineffective, and has not served to further the sound, efficient administration of fisheries" that I wish to direct my remarks today. I challenge that statement as incorrect and I call upon the drafters of the resolution to furnish proof of their assertions. The present organization is sound, it is logical, and it is effective. In the ten years it has been in effect, it has done more to further the interests of fishery management, conservation, and utilization than was accomplished in the three or four decades previously.

Memories about public affairs and previous events are short, and I feel that the drafters of the resolution that I have just mentioned must have been unfamiliar with the background and did not know the original reasons for the consolidation of the Bureau of Fisheries and the Bureau of Biological Survey. Such moves are seldom made without good reasons, as was the case in this instance. At the time of the merger in 1940, both of these predecessor agencies were weak and to a considerable extent were discredited in the public mind. The Biological Survey, which I joined in 1918 and in which, together with the present Fish and Wildlife Service, I have served continuously ever since, had suffered from weak administration for several years prior to the merger. Waterfowl, coming under Federal regulation under a treaty with Canada, had been consistently declining over a period of years. The only

remedy that the Bureau seemed to be able to prescribe was ever-shortened seasons and ever-smaller bag limits. Because of resultant public dissatisfaction and clamor, President Roosevelt appointed a special committee of citizens to study the problem and to recommend remedies. "Ding" Darling, the famous cartoonist, prominent in conservation circles in the Midwest, served on this special study committee. It recommended a positive action program--the acquisition and restoration of marshes along with severe restrictions on the take by hunters. Darling was induced to serve as Chief of the Biological Survey, an organization that had been virtually leaderless since the disability retirement of the previous bureau chief. He remained less than two years and was succeeded by Dr. Ira N. Gabrielson, an outstanding scientist and able administrator, but in 1940, when the merger came about, the public had not yet regained confidence in the efficiency of the administration of the Biological Survey.

A similar situation existed in the Bureau of Fisheries. It was a small organization and the morale of its employees, as well as the confidence of the public, suffered severely because of the quality of its leadership. Controversy raged, particularly in the Alaska fisheries field, where the bureau then had, and still has as the Fish and Wildlife Service, sole regulatory authority over the extremely valuable salmon and herring fisheries. We are still trying to live down some of the things that happened in Alaska in those days.

Government reorganizers concluded that there might be a strengthening of the administration of both fisheries and wildlife programs if the two closely related small bureaus were merged into one larger group. This has been the trend of government for many years and, with the exception of the recommendations for the transfer of the commercial fishery activities to the Department of Commerce, was also the philosophy of the Hoover Commission.

When the merger of the Biological Survey and the Bureau of Fisheries came about in 1940, the Biological Survey was on its way back into public esteem under the leadership of Dr. Gabrielson. It was, therefore, logical that he should become the first Director of the new Fish and Wildlife Service. As a minor employee in Washington at the time of this "shotgun wedding" of the two Bureaus, with Secretary Ickes, incidentally, holding the old double-barreled gun on us, I can personally testify that it was an unpopular move with the employees of both Bureaus, particularly those who revere tradition and the "good old days" of the past. I also know that the proposal to return to those "good old days" does not fall upon completely unsympathetic ears with some of the present organization. It is difficult to understand their philosophy, because I cannot think of a single individual who has not personally benefited in rank and salary by the creation of a larger and more important agency. With some, tradition is truly a potent factor.

But, of more importance to you and the other people we are paid to serve, did the mandatory trip to the altar pay off? Let us merely check the records.

First, let's review the appropriations for fishery work for the past 20 years--the ten years of operations under the present system and the ten years immediately preceding. Granted that during recent years the costs of operations have risen and appropriations have been more liberal to take care of these factors, appropriation figures are probably still the best over-all yardstick to measure the services the Government gives its citizens in matters pertaining to the fisheries.

In 1930, Federal fishery appropriations amounted to $2,498,550; in 1940, $2,421,075. That represents a decrease during the 10-year period of almost $100,000. The average for that period was approximately $2,000,000 per year. The fishery appropriations for the fiscal year 1950 amount to $10,875,251. Of even greater significance, the Budget which the President sent to the Congress within recent days and which Fish and Wildlife Service representatives justified before the Appropriations Committees a week ago carry proposed appropriations for fishery items amounting to approximately $12,000,000 for the fiscal year beginning next July 1. To be more specific as to

items in which you are most interested, the work of the Branch of Commercial Fisheries received $229,540 in 1940; $668,500 in 1950. The Branch of Fishery Biology received $390,835 in 1940 as compared with $1,546,000 in 1950; Alaska Fisheries, including the Pribilofs, from $516,460 to $1,480,100 in those 10 years. And the wildlife appropriations have likewise increased at the same time. In 1940, they amounted to $6,149,343, almost three times the then appropriated sums for fishery activities. For 1950, they amounted to $16,502,049. This sum included Duck Stamp and Pittman-Robertson revenues. Not bad for an "unsound, illogical and ineffective" organization!

At the time of the merger, not a single research or exploratory vessel was owned and operated by the Bureau of Fisheries. Now, the Albatross III is carrying on investigations extending from the Grand Banks to the Carolinas on the Atlantic Coast. Within recent months, two vessels, the Oregon and Alaska, have been acquired through special legislation and appropriations and are now stationed in the Gulf of Mexico. One will do exploratory fishing and the other will do biological research. A new vessel, the John N. Cobb, was commissioned at Astoria, Oregon, this month to carry out exploratory and experimental fishing in the North Pacific, reaching far into Arctic waters. The Black Douglas is carrying on experimental and biological work in an effort to find answers to some of the perplexing problems surrounding the pilchard fishery off the coast of California and lower Mexico. The Hugh M. Smith is conducting biological and oceanographic research, while the Henry O'Malley and the John R. Manning are doing exploratory fishing in the waters of the South Pacific in a program that has been developed in close cooperation with the tuna fishing industry of the West Coast. The Spencer F. Baird, the Theodore N. Gill, and the David Starr Jordan, three well-equipped research and exploratory vessels, are now completing a five-year study of the South Pacific fisheries in connection with the rehabilitation of the Philippines. It is planned that the Theodore N. Gill will soon be stationed in the Great Lakes to undertake the difficult study of the decline in that great fishery, made possible by special legislation and appropriations passed during the present session of Congress. And that adds up to 11 large vessels compared with not a single one at the time of the merger. In the entire previous history of the Bureau of Fisheries, reaching back to 1871, in fact, there were never at one time more than three ships doing that sort of work and that occurred for only 2 years. None had been in service since 1932--eight years before the merger. Does that add up to the assertion that the present Fish and Wildlife Service is an "unsound, illogical and ineffective" organization?

Ten years ago, the famous laboratory at Woods Hole, steeped in traditions of fishery research and oceanography since the days of Spencer Fullerton Baird, had been virtually abandoned. Within the past two years, we have rehabilitated the station, have transferred the scientific staff of the New England area there for headquarters, and the Albatross III is now berthed at Woods Hole. The laboratory at Beaufort, North Carolina, is being reconditioned and important studies in cooperation with the Atomic Energy Commission are being conducted at that point. A new laboratory is being constructed in Hawaii and the technology lab at Ketchikan, Alaska, has within recent months been enlarged and expanded. During that decade, a small laboratory was constructed in Puerto Rico, and fisheries research in the Caribbean area was carried on. In addition, the research stations at College Park, Maryland; Milford, Connecticut; Seattle, Washington; and Pensacola, Florida, have been expanded.

Never in the 80 years of government participation in matters pertaining to the fisheries has there been such great activity in the international field as there has been during the past few years. That is perfectly logical because of the increasing influence of the United States in world affairs. I should like to cite some of the more recent developments, however, as proof that fishery matters are not suffering at the hands of the present organization.

The Northwest Atlantic Fisheries Convention concluded just a year ago and ratified by the President last September 1

brings 11 nations having common interests in the North Atlantic fishing grounds under Treaty arrangements for the first time in history. The fisheries of this great area have been the battleground for some exceedingly tough international problems that date back to days prior to American independence. A Convention between the United States and Mexico for the establishment of an International Commission for the Scientific Investigation of Tuna was signed at Mexico City in January, 1949, and has been ratified by the President. A similar Convention between the United States and Costa Rica for the establishment of the Inter-American Tropical Tuna Commission was signed at Washington in May, 1949, and was ratified by the President on September 1, 1949. Three years ago, 22 nations, including Canada and the United States, met in Washington and arrived at an international agreement which established the International Whaling Commission, empowered to conduct investigations and regulate whaling throughout all the marine waters of the globe. In 1946, a Treaty was negotiated with Canada for the protection and management of the Great Lakes fisheries. This, so far, has been the least effective of the Treaty programs because of opposition of one or two States surrounding the Great Lakes.

I have mentioned some of the more recent developments but I should record also the continuing activities in connection with the Sockeye Salmon Commission which came into being in 1936, and which has now assumed regulatory powers after the first ten years of investigation. This has included the construction of the $2,000,000 fishway at Hells Gate on the Fraser River. I serve as one of the American members of this Commission. Assistant Director James is a member of the Halibut Commission, established in 1937, which has done a remarkable job of restoring the stocks of halibut along the stretches of the North Pacific Coast.

In the field of management of the fisheries of Alaska, I am proud of the progress that is being made. For the first time in history, we are now developing a closely integrated program, using all available manpower and equipment for enforcing both the fishery and wildlife laws and regulations in a joint operation. Enforcement of the fishery regulations is now vastly improved because of the use of Alaska game agents as well as about a dozen transferred from the States each season. During the war years the fishing regulations were probably more liberal than they should have been. This was due to the pressure for food for our own people and our allies. Many of our trained personnel were in the Army and Navy and many Service ships were devoted to military uses. Inadequate observations and patrol, together with over-fishing, created a serious depletion in the Alaska fishery. I am happy to say that it looks as though the situation is improving rapidly. Following severe restrictions during the past three years, the Southeastern Alaska pack of pink salmon responded to the point where the pack last year not only returned to but also exceeded the previous normal 20-year average. Two large vessels have recently been secured by transfer from the Navy to augment our Alaskan fleet, and several smaller ships have been built as a result of new appropriations by the Congress. In the Service's combined Alaskan operations, there are now owned and operated 18 vessels ranging from 40 feet to 150 feet in size, with 11 additional patrol vessels ranging from 30 to 40 feet. There are also about 100 speed boats used in fishery patrol. Within the past three months, the Service has taken over from the Army one of the best equipped marine shops on the Pacific coast. It is located at Juneau and is valued, at least, at $500,000. Surplus planes have been made available since the end of the war, and we now have a very excellent fleet of 20 planes which services both fishery and game agents in the Territory. Congress, last year, appropriated $250,000 for a new airplane hangar and shop at Anchorage, and as a result our facilities for observation and patrol will be much improved in future years. Moreover, Alaska regulations are now being made and enforced without fear or favor.

Ten years ago there were no effective means of correlating the needs of fish and wildlife with the construction programs of the Army Engineers and the Bureau of Reclamation. That is not the case

today. The Fish and Wildlife Service maintains a River Basin staff whose responsibility it is to review the plans of the construction agencies while the projects are in the making. We work in close coordination with these two bureaus. Much has been done to protect and increase the fishery potentials in the reservoirs because of this service.

The relations of the Fish and Wildlife Service with the Congress and the Bureau of the Budget are excellent. The needs of both fisheries and wildlife are given sympathetic attention both as to appropriations and as to legislation. This, in my opinion, is due in large part to the fact that practically every member of the Congress has a personal interest in something that the Fish and Wildlife Service is doing. If he or his constituents are not particularly interested in the commercial fisheries, it is a pretty safe bet that he either likes to hunt ducks and geese or he enjoys fishing for trout or bass or blue-gills. Maybe he comes from the West and is more interested in the coyote and ground squirrel control program of the Service, or perhaps he wants to go to Alaska to hunt moose or brown bear. It is an assured certainty that if there is a Federal fish hatchery in his district, he is anxious to see that it produces as many fish for his sportsmen constituents as can possibly be done. I doubt that there is another single agency of government that has such wide interest for so many people as do the varied activities of the Fish and Wildlife Service.

Last year there were fifteen and one-half million people who bought fishing licenses and almost thirteen million who bought hunting licenses. Another two million bought duck stamps to hunt ducks and geese. Many probably purchased all three kinds of licenses, but yet the fact remains that approximately one out of every five people in the United States is influenced in some degree by the activities of this Service. As such, the single organization known as the Fish and Wildlife Service wields much more power and influence than either the Bureau of Fisheries or the Biological Survey ever did before or would ever do again, if they were reconstituted separately.

I could continue this recitation for all day, but I fear that I have already used my allotted time. I shall close by inviting the members of the Resolutions Committee of the Pacific Fisheries Conference, or anyone else for that matter, who believes that the "consolidation by Executive Order of the former Bureau of Fisheries and the former Bureau of Biological Survey into one Bureau in the Department of the Interior, called the Fish and Wildlife Service, has been demonstrated as unsound, illogical, and ineffective" to take a little more careful look at the record. I sincerely believe that if those members of industry who are not satisfied with the present accomplishments of the Fish and Wildlife Service would tell us, and the Congress, frankly, what in the way of accomplishments they want but are not now getting, they will come closer to seeing it done than if they were to depend upon a much smaller agency, with much less prestige. Remember the appropriation figures I gave you -- $2,421,075 in 1940 as compared with $10,875,251 in 1950, and approximately $12,000,000 which President Truman has recommended to the Congress for next fiscal year. Again, I say, study the record.

BACTERIOLOGICAL FINDINGS IN THE STUDY OF AN OUTBREAK OF ULCER DISEASE AMONG BROOK TROUT YEARLINGS OF THE WESTFIELD, WISCONSIN, HATCHERY

Kenneth G. Flakas
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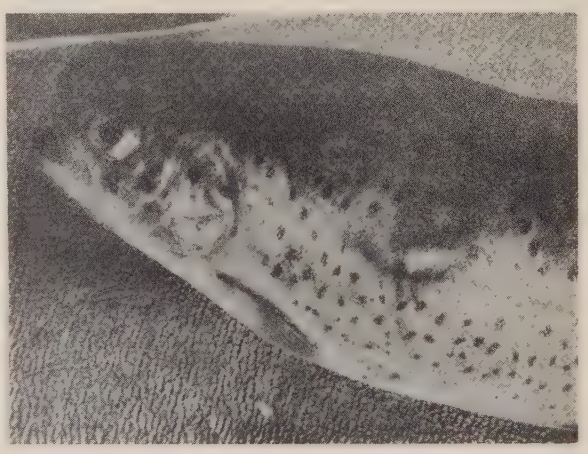
A BACTERIOLOGICAL study was made of a disease outbreak among the yearling brook trout (Salvelinus fontinalis) of the State trout hatchery at Westfield, Wisconsin. This outbreak was characterized by the occurrence of lesions similar in appearance to those described in ulcer-disease literature. Cultures of a Gram-positive rod and of an apparently altered strain of Bacterium salmonicida (the causative agent of the trout disease, furunculosis) were isolated in the Westfield study. By inoculating normal brook trout and brown trout (Salmo trutta) with cultures isolated from the Westfield brook trout, it was possible to produce experimentally lesions which resembled those found in ulcer disease.



(Photograph courtesy of author)

Experimentally produced "ulcer" lesion on brown trout.

DESCRIPTION OF ULCER DISEASE

For the most part, ulcer disease attacks brook trout. Brown trout and lake trout (Cristivomer namaycush) are susceptible to the disease in a much lesser degree, and rainbow trout (Salmo gairdnerii) are very resistant (Wolf 1939). The appearance of raised areas of tissue (called epithelial tufts) on the fins or body of the affected trout is one of the first symptoms of ulcer disease.

A typical lesion encountered in ulcer disease has a grayish-white central area surrounded by a ring of thickened, white epithelium having a reddened undersurface. The ulcer is usually a clean-cut circular area containing a light-colored exudate which can be easily removed (Davis 1946). The trout fins, body, and mouth and jaw may be attacked in this disease.

Ulcer disease differs from furunculosis in the lack of erosion of the deeper muscle layers and the absence of the dark-red boil-like areas--filled with a brownish fluid--that are found in furunculosis.

Calkins (1899) gave the first description of a brook-trout disease that undoubtedly was ulcer disease. Marsh (1905)

A contribution from the laboratory of the Fish Management Division of the Wisconsin Conservation Department.

reported on a brook-trout disease which was characterized by lesions similar to those found in ulcer disease. Moore (1924) described in detail the lesions of ulcer disease and called attention to some of the points of similarity to furunculosis. Fish (1934) provided a detailed description of the characteristics of ulcer disease and of some of the points of differentiation between ulcer disease and furunculosis.

Efforts to determine the specific causative agent of ulcer disease have met with varying degrees of success. Fish (1934) isolated a pathogenic bacterium (probably Pseudomonas hydrophilus) from the lesions of the disease, but he was unable to determine the relationship of this bacterium to the disease. Davis (1946) reported that Mrs. E. C. Lazar, a worker in his laboratory, had isolated--from brook trout that had ulcer disease--a bacterium that, when inoculated into normal trout, was capable of producing the epithelial tuft of early ulcer disease. The organism isolated by Mrs. Lazar was found to have the same cultural characteristics as B. salmonicida and was later found, by the use of serological methods, to be identical to this pathogen. The work by Mrs. Lazar indicated the possibility of the existence of a less virulent strain of B. salmonicida in ulcer disease.

THE WESTFIELD TROUT MORTALITY INVESTIGATION

In October 1948, the Westfield hatchery yearling brook trout, which were kept in all-concrete raceways, had been subjected to some unavoidable crowding and this had resulted in some incidence of fin rot. The fin pathology was characterized by white, patchy areas on the dorsal fins and some loss of fin structure. During the October investigations, the mortality rate of the Westfield trout remained at a normal level and the external lesions of ulcer disease were not seen. Bacterial cultures which were taken of the Westfield trout in October were repeatedly negative for pathogenic bacteria.

In the second week of November 1948, the mortality rate of the Westfield trout began to rise slightly and some of the daily mortalities exhibited external lesions which resembled those of ulcer disease. Most frequently the lesions were found at the base of the caudal fin, affecting both sides of the body; however, unilateral lesions also were found on the bodies of the daily mortalities. The head and mouth parts appeared to be free of any sign of disease. The external lesions on the Westfield mortalities measured approximately 1 by 2 inches and showed a central circular area of white (dead) tissue with a narrow reddened ring at the periphery. On many trout examined, the white central area had been sloughed, leaving an ulcerous lesion with the superficial muscle layers either grayish or light pink. There was no apparent involvement of the deep muscle layers, but some erosion of the superficial muscle coats was noted. The lesion exudate was light gray, sometimes showing a faint trace of red.

An examination of the internal organs failed to reveal any significant findings other than the occasional occurrence of a reddened hind gut. Scrapings of the lesion material, the body slime, and the intestinal contents were negative for any parasitic infestation. With fish infusion agar (pH 7.6) as a medium, bacteriological cultures were made of the lesions, kidneys, and intestines of the affected trout.

BACTERIOLOGICAL FINDINGS

Cultures of a nonmotile Gram-positive rod (Culture No. 1) were recovered consistently from the kidneys and lesions of the affected Westfield brook trout. The Gram-positive rod was 0.5 by 1 to 2 microns in size. It occurred in both diploid and chain formation and produced minute, circular, transparent colonies on fish infusion agar.

Several cultures of a Gram-negative rod (Culture No. 2), which produced transparent colonies of the spreader type of growth, were also recovered from the lesions of the Westfield trout. The Gram-negative rod (Culture No. 2) measured 0.5 by 3 to 4 microns, exhibited some curving, occurred singularly, and was

pointed at the ends.

When broth cultures of the Gram-positive rod (Culture No. 1) were injected intramuscularly into normal 2-year-old brown trout and yearling brook trout, a low-grade, nonfatal infection was produced, as evidenced by the occurrence of a nonhemorrhagic swelling at the site of inoculation. Several of the experimental brown and brook trout, which had been injected previously with 0.05 cubic centimeter of a broth culture of the Gram-positive rod (with a resultant production of a low-grade infection), were given a secondary intramuscular injection with 0.05 cubic centimeter of a broth culture of the Gram-negative rod (Culture No. 2). Four days after the injection of Culture No. 2, the experimental trout died, exhibiting nonhemorrhagic (external) swellings at the sites of inoculation (see figure). Removal of the skin from the area of inoculation revealed the presence of peculiar "knife-cut" lesions which exuded a pale-pink fluid. The lesions produced differed from those found in furunculosis in that: (1) these lesions were narrow cut-like areas of erosion going into the muscle layers without the marked hemorrhaging and break-down of tissues commonly found in furunculosis, and (2) these lesions contained a light-pinkish exudate--in contrast to the characteristic dark-brown pus-like exudate of the furunculosis lesions.

Direct smears taken of the lesion exudate from experimentally infected trout revealed the presence of many Gram-positive rods occurring in diploid and chain formation, plus a rare, small Gram-negative rod. Cultures were made from the lesions, kidneys, and heart blood of the experimentally infected trout. After 5 days of incubation at 20° C., all the cultures had a heavy growth of a Gram-positive rod, in diploid and chain formation, which had the characteristics of the original Culture No. 1. The heart, blood, and kidney cultures had, besides the predominating growth of the Gram-positive rod, a few minute transparent colonies of a small Gram-negative rod in diploid formation.

None of the original cultures taken from the experimentally infected trout showed any of the pigmentation associated with B. salmonicida. When several of the minute transparent colonies of the small Gram-negative rod, found in the heart blood and kidney cultures of the experimentally infected trout, were transplanted to agar slants, the resultant growth showed the typical brown pigmentation of B. salmonicida after 4 days of incubation at 20° C. Inoculation of the resultant cultures of B. salmonicida into normal 2-year-old brown and yearling brook trout, produced the typical furuncles and attendant fatal septicemia of furunculosis.

When serial transplants were made of the cultures of the Gram-negative rod (Culture No. 2, isolated in the original bacteriological study of the Westfield trout), it was found that the spreader type of growth of this culture contained a few of the bacteria that ordinarily cause furunculosis, B. salmonicida. The number of B. salmonicida in the spreader type of growth was so small as to make their detection difficult. It is of interest to note the relative numbers of the two bacteria apparently involved in the disease at the Westfield hatchery. Ordinarily, in active furunculosis, the affected trout has a large number of the causative agent B. salmonicida present in both the heart blood and the kidneys. In the Westfield ulcer disease, the number of B. salmonicida present was very small and a Gram-positive rod predominated in all the cultures taken. Pure cultures of the Gram-negative rod producing the spreader type of growth failed to produce any symptoms of disease when inoculated into experimental trout.

The cultures of the small diploid Gram-negative rod, recovered from the heart blood and kidneys of the Westfield trout, which showed marked brown pigmentation on transplanting, were found to have the biochemical reactions and pathogenic properties that characterize B. salmonicida.

The Gram-positive rod, isolated in the study of the Westfield mortalities, gave the following biochemical reactions: the production of acid in maltose, dextrose, and sucrose, but no change in lactose and mannital; reduction of nitrate broth; no production of indol in peptone broth; no liquifaction in gelatin; and the production of a slight amount of

acidity in litmus milk.

That we are not dealing with furunculosis in its active state, in this disease outbreak at the Westfield brook trout hatchery, is indicated by the following facts:

1. The mortality rate among the affected trout has remained consistently at a low level. This may be due to the disease-arresting attributes of cold water temperatures such as were reported by Wolf (1939).

2. The lesions found on the Westfield trout are not of the type usually found in furunculosis but are similar to those described in literature relating to ulcer disease; that is, these lesions possess a white ulcerous center with a periphery of reddened tissue and are localized in the superficial muscle layers.

3. The cultures taken of the Westfield trout mortalities showed a predominating growth of a Gram-positive rod and but a very few colonies of B. salmonicida, in contrast to the overwhelming septicemia (B. salmonicida) found in active furunculosis.

4. When the cultures isolated in the original study of the Westfield mortalities were injected into experimental trout, the lesions produced were unlike those found in experimentally produced furunculosis.

The exact relationship of the Gram-positive rod and B. salmonicida to the final disease condition encountered in the Westfield brook trout will have to be studied more thoroughly before definite statements can be made as to the exact etiological relationships of the bacteria isolated in this study. Theoretically, ulcer disease may be the end result of the action of a bacterium of low virulence, such as the Gram-positive rod which was isolated, combined with the action of an arrested form of a usually highly virulent organism, such as B. salmonicida. As B. salmonicida is playing a part in the disease condition at the Westfield hatchery, the affected trout are being treated with a combination of sulfamerazine and sulfaguanidine in an effort to rid the affected trout of the disease.

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BIOTIN AND BROWN TROUT: THE TALE OF A VITAMIN

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FOR THE PAST decade or so, brown trout in Federal hatcheries within Region Five of the Fish and Wildlife Service have been subject to a disease that has resulted in serious difficulty in rearing these fish. Characteristic of this disease is a bluish film which covers the trout's body. As some of this coating eventually sloughs off, giving the trout a patched appearance, this disease is popularly designated as "blue-slime" or "slime-patch." In spite of treatments of every known variety, little more than temporary relief has been given and huge losses have resulted.

For the most part, the appearance of blue-slime disease can be correlated with the widespread use of dry feeds in the diet and the subsequent elimination of beef liver from the food. Either beef or pork spleen is used as a substitute for beef liver. This has led to the speculation that blue-slime was in some manner connected with the diet of trout and that perhaps the use of dry feed was detrimental to this species.

One of the interesting side lights of the early studies upon blue-slime was that after serious losses for a period of 4 to 8 weeks the trout appeared to recover and the remaining fish were reared through the rest of their hatchery life without any serious losses from this condition. It was also noted that the disease usually appeared at approximately the same time each year and disappeared after approximately the same interval of infection. Furthermore, it was noted that in many instances the apparent cure came about without any change whatsoever in the diet of the fish. Certainly this evidence was hard to reconcile with the earlier statement that blue-slime became widespread about the time that large-scale changes in hatchery feeding practices took place.

Blue-slime disease did not seem to be particularly infectious, as brook and rainbow trout that were held in the same hatcheries (and frequently in series with afflicted brown trout) did not show symptoms of the disease. Cases of blue-slime have been reported, however, among both these species of trout.

In 1947, Phillips and his associates (Phillips et al., 1947) reported that brown trout showed a higher requirement for biotin than did either brook or rainbow trout. Rodgers felt that in view of this increased need, it might be well to test the effect of biotin sources upon blue-slime. His experiments (Rodgers 1949) showed that the addition of beef liver to the diet soon eradicated the trouble and that the trout remained free of the disease as long as the diet contained liver. Phillips, Brockway, and

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Region Five of the Fish and Wildlife Service includes the States of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, New Jersey, Delaware, Maryland, West Virginia, and Ohio.
--The EDITORS.

Rodgers (1949) reported that brown trout which were fed cod-liver oil showed an increased incidence of blue-slime and an increased mortality. As biotin is a growth factor and cod-liver oil increased the rate of growth of fish, these authors indicated that perhaps the lack of biotin was the cause of this disease.

With all this somewhat conflicting information at hand, it was decided that experiments would be set up to try to determine whether blue-slime was a dietary disease and whether some of the apparent irregularities outlined could be explained on a nutritional basis. These experiments were conducted during this past summer at the Cortland Experimental Hatchery, Cortland, New York.

METHODS

Duplicate experiments were arranged in the experimental hatchery, where the fish were held in troughs supplied with water at a temperature of 47° F. The diets fed are listed in table 1.

The experiments were conducted in the usual established manner of this hatchery, which has been described previously (Tunison et al., 1939).

Because of the excessive cost and the physical characteristics of biotin, it is difficult to feed the vitamin, as such, to fish; hence beef liver and dried brewer's yeast, two sources rich in biotin, were fed. For a study of the time element, the data were grouped into three series and analyses of the trout liver were made at these times to determine the biotin storage. Each series covered about 5 weeks. By means of analyses, it was possible to correlate the appearance of blue-slime with the biotin level in the liver. This would reflect the vitamin in the diet and its degree of utilization.

The data have been summarized in table 2. For greater technical detail, the reader is referred to the annual report of this station for the years 1947 and 1949 (Phillips et al., 1947; in press).

DISCUSSION

The omission of either beef liver or brewer's yeast from the diet of these trout resulted in an excessive loss of fish and the occurrence of blue-slime throughout the experimental period. In fact, the mortality was so great among fish fed Diets No. 1130 and 1131 that all the fish were dead by the end of the second series of analyses and the experiment was automatically concluded.

TABLE 1.--Diet composition in percent

Diet No.	Beef spleen	Dry[1/] mix 6a	Beef liver	Yeast	Cod-liver oil
1130	47	50	-	-	3
1131	47	50	-	-	3
1132	50	50	-	-	-
1133	50	50	-	-	-
1134	27	50	20	-	3
1135	27	50	20	-	3
1136	45	50	-	5	-
1137	45	50	-	5	-
1138	30	50	20	-	-
1139	30	50	20	-	-
1140	42	50	-	5	3
1141	42	50	-	5	3

[1/] Composed of 24 parts each of wheat middlings and cottonseed meal, 48 parts of fish meal, and 4 parts of salt.

TABLE 2.--Summary of biotin experiments

Diet No.	First series				Second series				Third series			
	Average weight of fish - grams	Millimicrograms[1] biotin per gram of fish liver	Percent loss	Blue-slime	Average weight of fish - grams	Millimicrograms[1] biotin per gram of fish liver	Percent loss	Blue-slime	Average weight of fish - grams	Millimicrograms[1] biotin per gram of fish liver	Percent loss	Blue-slime
1130	1.66	0.502	13.9	Yes	0.93	0.411	31.4	Yes	(2)	--	--	--
1131	1.74	0.609	3.5	Yes	1.64	0.543	27.0	Yes	(2)	--	--	--
1132	1.56	0.568	12.0	Yes	0.96	0.543	23.6	Yes	0.63	0.331	26.0	Yes
1133	1.83	0.674	15.2	Yes	1.72	0.600	29.1	Yes	2.75	0.436	86.0	Yes
1134	2.06	0.936	2.1	Yes	3.78	1.058	4.1	No	7.05	1.192	1.2	No
1135	2.12	0.849	3.4	Yes	3.72	1.066	2.1	No	7.03	1.083	0.9	No
1136	1.88	0.833	3.3	Yes	3.30	0.993	2.7	No	6.05	1.136	1.2	No
1137	1.88	0.827	1.3	Yes	3.44	1.034	1.2	No	6.04	1.097	1.0	No
1138	1.81	0.882	3.3	Yes	3.08	1.026	6.4	No	6.00	1.203	1.8	No
1139	1.83	0.846	3.3	Yes	3.10	1.103	6.5	No	5.89	1.323	1.5	No
1140	1.98	0.823	2.9	Yes	3.60	1.035	1.6	No	6.90	1.102	0.9	No
1141	1.90	0.752	2.4	Yes	2.37	1.058	1.9	No	6.50	1.199	0.9	No

[1] Expressed in thousands.
[2] Complete loss at the time of the third series.

It will be noted that the biotin storage in these trout was extremely low in comparison to that of fish fed liver and yeast. Certainly the addition of either of these products made an outstanding difference in the rearing of brown trout. A glance at the average weight of the fish at the time of the various series of analyses will show the lack of growth among fish affected by blue-slime.

When the data are considered from the time angle, it will be noted that during the first series all the fish showed symptoms of blue-slime disease. By the time of the second series, however, only those fish which were fed a diet that lacked yeast or liver showed such symptoms. In other words, in all the other experiments (fish fed Diets No. 1134 through 1141) the disease disappeared with no change in the diet. It will be noted that there was a definite increase in the biotin storage of these fish at the times of the second and third series of analyses. Why fish will "cure" themselves is now more clearly understood, as there is an apparent increased requirement of biotin among smaller brown trout. Even the amounts furnished by the yeast- or liver-fortified diets were not sufficient to prevent the occurrence of blue-slime among these fish. Because fish size is the essential factor in these experiments--note the average weight of the fish for the three series--it may be said that the apparent "cure" of brown trout without a change of diet may be placed at the door of nutrition.

A comparison between the diets containing cod-liver oil and those lacking this substance proved interesting. First, the diets that contained no biotin fortification but included cod-liver oil (Diets No. 1130 and 1131) produced a complete loss of fish by the end of the second series of analyses. Those fish that received a similar diet but no oil (Diets No. 1132 and 1133), although showing an excessive loss, did manage to last the entire experimental period. It will also be noted that in all other instances the average weights of the fish that were fed diets containing the oil exceeded the average weights of the fish fed comparable but oil-less diets (Nos. 1134 and 1135 vs. 1138 and 1139; 1136 and 1137 vs. 1140 and 1141). This is in substantial agreement with previously reported experiments on the use of cod-liver oil in trout diets. It is also interesting to note that in the fortified diets the addition of cod-liver oil did not result in an increased loss of fish, and therefore this practice may be used to increase growth of brown trout if there is sufficient biotin in the diet.

It should be emphasized that either beef liver or dried brewer's yeast was capable of preventing blue-slime disease. Frequently the use of the yeast would be a far more economical practice, and in most areas this would be more readily available. For fish having an average weight of less than 2 grams, however, it is suggested that if liver is fed, the level be not less than 33-1/3 percent, and if yeast is the supplement, it be fed at a minimum of 8 percent. It would probably be possible to feed a combination of the two at perhaps 15 percent of liver and 5 percent of yeast, thus resulting in a cheaper combination.

From the reports we have received, it appears that if denatured fluke-infested livers are used, either the purple-dyed or charcoal-rolled livers are satisfactory. There is some evidence that the common green-dyed liver is not nearly so effective.

The appearance of blue-slime about the time of the widespread changes in hatchery diets now appears most reasonable. Because the removal of beef liver from the diet eliminated one of our own most potent sources of biotin and the addition of the spleens did not offer a good source of biotin, the appearance of blue-slime can logically be correlated with diet changes. The dry-feed mixtures used in our present-day diets are not particularly good sources of biotin, for the most part; hence some additional biotin concentrate should be added to the diet. Cheaper meats and dry concentrates can certainly be used to advantage if this simple precaution is taken.

As all the foregoing merely pointed the finger at biotin and gave no definite proof that the vitamin itself was the agent, two experiments were set up in

an attempt to show that blue-slime and biotin were blood relations. Egg white has the unhappy faculty of causing a biotin deficiency in higher animals, tying up the biotin so that it is unavailable to the animal. It was thought that if egg white were added to a fortified diet, then the appearance of blue-slime could be attributed to lack of the vitamin. Experiments were made with brown trout which averaged 12 grams in weight. After a period of 8 weeks there were unmistakable symptoms of blue-slime among the fish receiving egg white, whereas the control fish were free of any such signs. No excessive loss resulted; it is felt that the large size of the trout prevented such a loss.

It certainly appears that biotin is going to be our corrective agent. Several hatcheries troubled with blue-slime have now used either beef liver or yeast as a corrective measure, and all the reports have been highly favorable.

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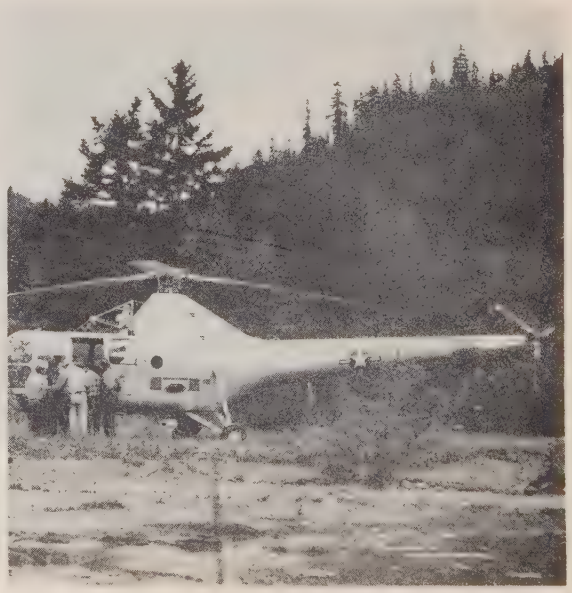
Brown trout netted at Spearfish, South Dakota.

(Photos by U. S. Coast Guard)

During the fish-planting work on alpine lakes of Olympic National Park, a small clearing at Lake Crescent served as a base of operations for the helicopter made available by the U. S. Coast Guard.



THE HELICOPTER IN FISH-PLANTING OPERATIONS IN OLYMPIC NATIONAL PARK

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IN OLYMPIC National Park there are numerous small lakes at elevations ranging from 4,000 to 5,000 feet above sea level. These lakes are subjected to moderate to heavy fishing pressure, which, coupled with poor spawning conditions, makes fish planting necessary to provide satisfactory fishing and maintain a suitable stock of fish in the lakes. For many years rangers, employees of the State game department, and sportsmen have carried fish to these lakes by means of horse and mule pack strings and back packs. Because of the rugged terrain, poor trails, and the widely separated locations of the lakes, these methods are inefficient and costly.

As many conservation agencies in the West have developed the use of aircraft for planting high mountain lakes, it seemed advisable to utilize this method to plant fish in the alpine lakes of Olympic National Park. The U. S. Coast Guard Air Station at Port Angeles, Washington, is just north of Olympic National Park. Coast Guard officials offered the use of aircraft and base facilities for this operation, and the U. S. Fish and Wildlife Service, in cooperation with authorities of the National Park Service, planned and supervised the planting of 12 lakes in the Park.

A Sikorsky helicopter and fixed-wing aircraft having flight characteristics suitable for fish-planting work were available. The small size of the lakes (5 to 20 surface acres) and the presence of high cliffs adjacent to these lakes made the use of the helicopter advisable. Another factor in this decision was the desire to obtain information in regard to the advantages of using a helicopter rather than fixed-wing aircraft and to learn more about special problems in carrying fish in this type of aircraft.

Coast Guard personnel at the base constructed a tank for carrying the fish in the aircraft. This tank is patterned after one used by the Washington (State) Department of Game in its fish planting from the air. The tank is designed for use in either a helicopter or a fixed-wing aircraft. Constructed of welded sheet aluminum, the tank is 12 inches wide, 14 inches deep, and 30 inches long. A cover held in place by wing nuts is provided.

A partition which can be removed in flight divides the tank into two compartments of equal size, making it possible to plant two lakes during one flight. In the bottom at one end of the tank there is a port for the release of the fish. The release-port cover, controlled by a lever mounted on the side of the tank, swings up into the tank. Proper adjustment of the lever system, the presence of a rubber gasket around the port, and the pressure of the weight of water in the tank provide a watertight seal. No difficulty was experienced in releasing the fish with the port opening inward.

It was planned that aeration would be effected by an air funnel mounted on the side of the tank with tubing leading into each compartment. Rubber tubing from the funnel to the tank has an inside diameter of 3/8 inch, and the metal tubing inside the tank is 5/16 inch. It was

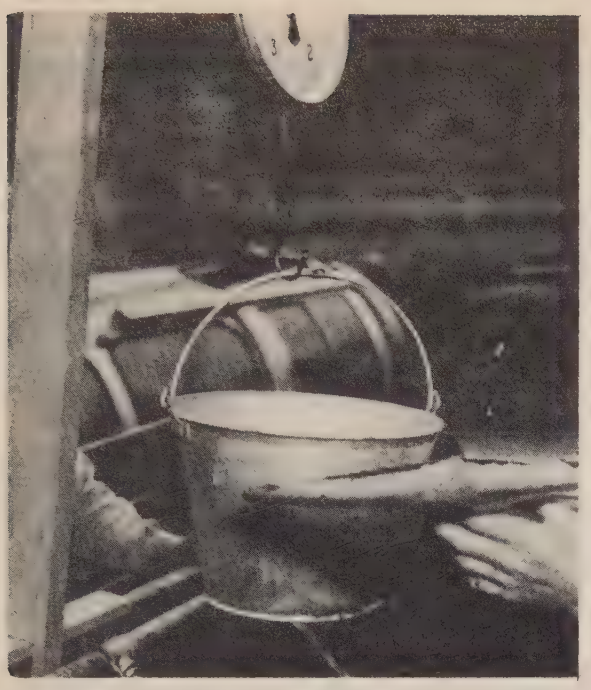
Fish-carrying tank: air funnel and tubes of aerating system on left-hand side; release port, opened by the lever on right-hand side; slot for insertion of partition, middle of tank.

When tank is loaded, the cover will be secured by wing nuts.

found, however, that this system did not function on the helicopter. At operating air speeds from 40 to 80 knots, the weight of water in the tank prevented the air from entering the water except when the inside end of the tube was within 1-1/2 inches of the water surface. Varying the size of the funnel and directing the funnel at various angles so as to take advantage of the thrust from the rotating blades as well as the forward motion of the aircraft, made no noticeable change. It was found, however, that up to 5 pounds of trout fry could be carried without aeration during the one-half hour required for the Olympic National Park plants. The vibration of the aircraft set up considerable surface agitation, which undoubtedly provided some aeration. A small oxygen tank would provide adequate aeration when the fish tank is used in a helicopter and would eliminate the necessity of an air funnel should the tank be used in a fixed-wing aircraft.

As air currents are unpredictable and uncertain in the rugged country in which the lakes are located, and as most lakes lie in pockets with cliffs nearby, the helicopter pilot, Lt. (j.g.) S. H. Raumer, preferred to drop the fish at an altitude of about 100 feet above the lakes and at an air speed of 40 knots. Several practice drops (in which the tank held only water) were made on a target on the runway of the Coast Guard base. Unexpected accuracy was achieved. It was found that fish could be dropped consistently into an area of less than 1 acre when wind velocities were not great. On August 6 one lake scheduled to be planted was still ice-covered except for a fraction of an acre of open water. The fish dropped as a test landed directly in the center of the open water. In every operation the lakes were successfully hit.

The obstacle hardest to overcome was the weather. The Olympic Mountain area is noted for its heavy rainfall. Over much of the year this area is a flyer's nightmare, and it was just that when the preparations for the planting from the air were completed. A heavy cloud cover at 4,000 to 6,000 feet (the altitude of the lakes) kept operations at a standstill for 3 days. After this period of waiting



Fish being transferred directly from fish-distribution truck to the aircraft.

When fish are released during flight above the lake, the thrust of the rotor blades forces fish and water almost straight down--but only for a few feet below the helicopter.

there was a break in the clouds over some of the lakes and the route to them. The fish were quickly loaded and a take-off was made. It was found that in the area of the lakes shifting cloud masses were closing in and then moving away from the lakes in unpredictable fashion. It was therefore impossible to know, when the plane was loaded with fish for the take-off, which lake would be open enough for planting. Planting allotments for the various lakes had been made up on the basis of lake size, food present, spawning success, and fishing pressure. These allotments ranged from 2,000 to 16,000 feeding rainbow trout fry, but most of the allotments, fortunately, were grouped around 5,000 and 10,000 fish per lake. The tank was therefore loaded with 10,000 fish divided equally in the two compartments and trips were made to the lake areas, where the fish were planted in whichever lakes scheduled for planting were free of clouds.

Upon reaching the lake to be planted, the pilot would circle several times to determine the direction of the wind (often impossible to determine) and the locations of cliffs and trees. Most of the lakes in the Olympic Mountains are in glacial cirques that have precipitous sides. Sometimes it was necessary to approach the lake from the open end of the cirque, make a tight turn at the upper end of the lake, drop low and decrease air speed for the fish drop, and then leave the lake through the open end of the cirque. Where there were no cliffs at the upper ends of the lakes, it was possible to make an approach low over the mountain meadows often present in such areas, drop the fish, and depart over the lower ends of the lakes, which, except for trees, are always open. After the release of the fish, a quick turn would be made to permit observation of the fish and water striking the lake surface. From the air, this looks much like a small rain squall on the smooth water surface.

One important advantage of the use of a helicopter is the flexibility of the operation by reason of the fact that only small clearings are required for landings and take-offs. Several of the lakes planted were in the northwest corner

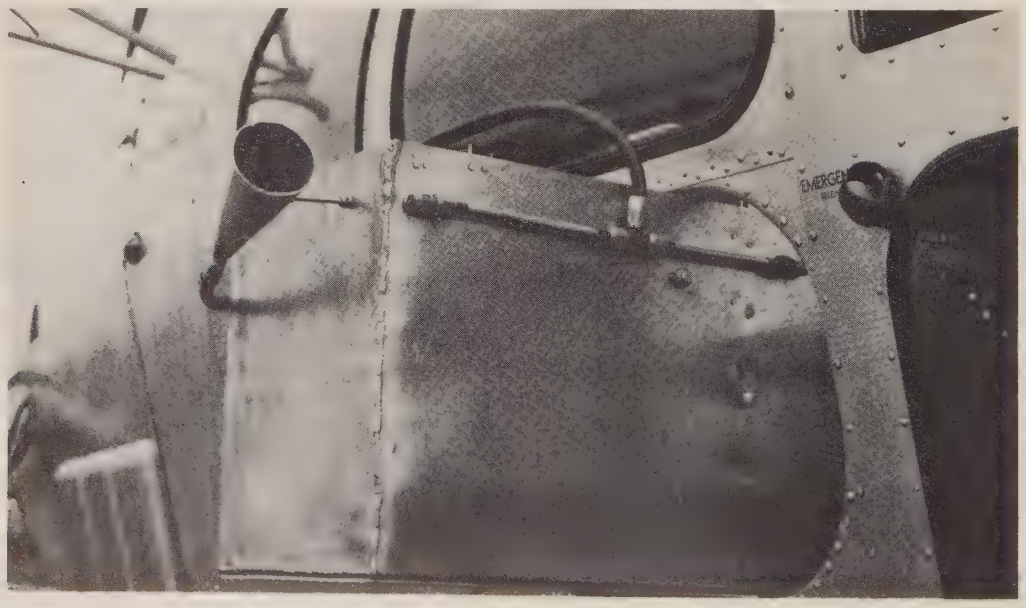
of the Park. From a small flat clearing at a resort on Lake Crescent, a round-trip flight of only 36 miles was required to plant the lakes. The rainbow trout were hauled by truck from the U. S. Fish-Cultural Station at Quilcene, Washington, to Lake Crescent, where they were held in live boxes in the lake until loaded in the aircraft. A schoolyard at Quilcene was used as a base of operations for planting lakes on the west side of the Park. The schoolyard was only 2 miles from the Quilcene fish hatchery--which facilitated the handling and loading of the trout. Telephone lines bordered two sides of the schoolyard (less than a block square), and school buildings were on the third side. In landing, the helicopter would approach from the open side, hover over the yard, turn around on its axis, and settle down facing the open side of the yard--ready for take-off. The combination of fish and helicopter in the schoolyard created such excitement that the town of Quilcene practically suspended business whenever fish were being loaded and the aircraft was arriving and departing. Fish for the planting of a lake on the north side of the Park were hauled by truck to the Coast Guard base at Port Angeles and there put on the helicopter.

Use of a helicopter in fish-planting work in rugged mountain country is regarded as highly successful. The advantages of the helicopter over fixed-wing aircraft in fish planting in mountainous country may be summarized as follows:

1. Greater maneuverability in difficult flying conditions among cliffs and trees.

2. Slower speeds and lower altitudes over lakes as the fish are dropped, making it possible to assure that the fish are planted in the water and not over surrounding terrain, and making it possible to plant smaller lakes successfully.

3. Landing-space requirements which permit utilization of small clearings close to the lakes to be planted, thus cutting down the flying time required and enabling the establishment of a base of operations where water is available for the holding of fish in live boxes until loaded for flight.



FISHERY RESEARCH PROGRAM AT CORNELL UNIVERSITY

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THE PRINCIPAL fishery projects at Cornell University are long-term investigations (5 to 10 years or more) set up to evaluate planting of hatchery-reared fish, to obtain various population statistics which are valuable to fishery management, and to contribute to the general fund of knowledge regarding fishery biology. It is hoped that the information presented here will be useful to indicate the nature of the problems being studied and to provide stimulus for comment and criticism which may be of assistance in the planning of future work.

A considerable number of the investigations are of a cooperative nature, involving the U. S. Fish and Wildlife Service, the New York State Conservation Department, and local sportsmen's organizations, as well as the University. An effort has been made to integrate the student training program, particularly at the graduate level, with these long-term researches.

Cayuga Lake, which, with its tributaries, is the principal site of our activities, is one of the Finger Lakes of central New York. The lake is long and narrow in outline and has an area of some 66 square miles. Much of the water is more than 100 feet in depth; the maximum depth is 435 feet. The lake offers typical lake trout habitat.

The studies on Cayuga Lake have centered about smallmouth black bass (Micropterus dolomieu), rainbow trout (Salmo gairdnerii), and lake trout (Cristivomer namaycush). It has been found neither possible nor desirable, however, to exclude consideration of several other abundant species such as the rock bass (Ambloplites rupestris), which presumably is highly competitive with the more desirable smallmouth; the alewife (Pomobolus pseudoharengus), the predominating food fish eaten by all piscivorous species; the smelt (Osmerus mordax), which has exhibited a tremendous increase in abundance since 1946; and the sea lamprey (Petromyzon marinus), which is common in Cayuga Lake as well as in Seneca, the sister lake to the west.

SMALLMOUTH BLACK BASS

Studies of the smallmouth black bass were initiated in 1941. Major emphasis has been placed on collecting catch statistics from a concentrated fall population in an area of Cayuga Lake known as Flat Rock. This census work has been paralleled with the tagging of bass and the release of fin-clipped hatchery fingerlings. Some 44,000 fin-clipped hatchery fingerlings have been planted to date. The accumulated survivors of these hatchery fingerlings are currently prominent in the population structure and catch of legal-size bass in the general area in which they were planted.

Bass tagged and recaptured at Flat Rock provide a means for the estimation of population size which may be compared with independent estimates based on the catch per unit effort. The summer dispersion of this population, considered in the light of high recoveries back at Flat Rock in subsequent autumns, poses

Paper presented at 79th Annual Meeting of American Fisheries Society, Sept. 14-16, 1949, at Winnipeg, Manitoba.

an intriguing problem on the stimulus responsible for directing the bass into the wintering grounds at Flat Rock.

LAKE TROUT

The lake trout in Cayuga Lake are of particular interest because the fishery has increased tremendously in the past few years. The size of the catch has increased from hundreds to thousands of trout a year since 1946. Though the increased population was present for several years prior to 1946, it remained virtually unexploited, owing to (1) the general opinion that lake trout fishing in Cayuga Lake was poor, and (2) the excellence of the trout fishing in the neighboring Finger Lakes, particularly Seneca and Keuka.

During the past 4 years, 135,500 lake trout have been fin-clipped and planted. The State stocking policy has been to plant from 60,000 to 100,000 fingerling trout (20 to 50 percent of which have been marked) late in the summer. In addition to the fingerlings, 5,000 to 10,000 fin-clipped yearling trout are planted early in the spring.

Gill netting to recover these marked trout was carried on intensively in 1949. Though the sample of juvenile trout taken was not large, it was sufficient to indicate a considerable proportion of marked hatchery fish in the population of small trout.

SEA LAMPREY

As indicated previously, the sea lamprey occurs in some numbers in Cayuga Lake, and it is interesting to note that the lake trout population has undergone such a marked increase in numbers despite the depredations of the lampreys. Virtually the total population of trout more than 20 inches long shows evidence of lamprey attack, either fresh wounds or old scars, the average number of both being currently about 5.5 per trout. (This is about three times the damage that New York State Conservation Department workers observed in Seneca Lake trout during 1949.)

Data on incidence of attack indicate an increase in 1948 and 1949 over that observed in previous years. Furthermore, the condition of the 1949 population may be shown to be significantly lower than that for earlier years (1944-46). That a decrease in condition should occur concurrently with an apparent increase in lampreys readily appears, however, to be coincidental. There is no significant difference in the weight-length relationship between trout exhibiting a high incidence of attack and those showing a low incidence.

It would appear that an explanation for the reduction in weight is more likely to be found in nutrition. The populations of highly carnivorous species in the form of lake trout and smelt have undergone tremendous increases; there is some evidence that the important forage fish, the alewife, is currently present in diminished numbers; and at least one other species, the smallmouth black bass, has recently exhibited significant decreases in growth rate.

Aquarium studies at the University Fish Hatchery have indicated a high mortality when sea lampreys attack small fish and suggest selectivity in the size of the host preferred. The positive correlation that exists between fish size and number of lamprey attacks is presumably due to the fact that older fish have been longer exposed to attack, but the possibilities of selectivity cannot be ignored. The lower incidence of wounds and scars on small lake trout may find some explanation here, or perhaps attacks on small trout are more often fatal and hence go unobserved.

RAINBOW TROUT

Although rainbow trout have been more or less systematically planted in tributaries of the Cayuga watershed for a number of years, no population which approaches those of the other Finger Lakes has been established. Cayuga Lake seemed to offer similar potentialities, and when the project was initiated in 1946, it appeared that there was a niche in the environment which could be filled by the rainbow trout.

An attempt to establish a population through hatchery means offered many research possibilities, particularly in view of the importance of the species as a sport fish in the Finger Lakes region. And in the event that an appreciable spawning run was forthcoming, then the necessity for continued stocking would provide a fruitful field of investigation.

The program to date has consisted largely of planting hatchery-reared trout. Thus far, 39,000 hatchery-reared rainbow trout have been fin-clipped and stocked. The trout, 5 to 9 inches in length, were placed directly in the lake. It was hoped that by this means it would be possible to avoid the vulnerable period of stream life and to relieve the competition for the smaller food organisms that might exist if large numbers of fingerling trout were stocked. (Presumably, the large trout could utilize the alewife population from the time they were stocked.)

Thus far, recoveries by angling and by netting have been meager, although the specimens taken have exhibited rapid growth. A few fish, mostly males, have appeared in the spring spawning run, but there has been virtually no natural reproduction.

BROWN TROUT

Studies on the survival of brown trout in a stream are being conducted in Fall Creek, the largest tributary of Cayuga Lake. During the past few years there has been considerable discussion regarding poor survival of hatchery trout in some waters. Studies designed to inquire into possible reasons for this seemed a profitable, although complex, field in need of investigation.

The possible effect of growth rate on survival was the problem selected for initial work. Among most trout hatcheries, the production of the largest possible fish in the shortest possible time seems to be a well-established objective, and the present tendency is to stock with more large trout. From nutritional experiments on other animals, however, there is good evidence that increased growth rates may result in shortened life spans.

An experiment designed to yield some information on this subject has been a vexatious one to set up. It was decided to control growth rate by temperature rather than by food intake. This was feasible inasmuch as the U. S. Fish Hatchery at Cortland, where the trout were to be reared, had two available sources of water--one of 47° F. and the other averaging 54° F.

The planting schedule, showing ages and lengths for these two lots of trout during the 1949 and 1950 seasons, is presented in the table.

All the trout come from the same brood stock and receive similar food fed according to standard feeding charts. The three groups available for the 1950 planting (and replicated as long thereafter as may be considered desirable) permit two comparisons of the survival between the slow and rapid growth rates: one in which the size of the two lots is the same, but in which there is an age differential of 1 year; a second in which trout of the same age are involved, but which exhibit a size differential.

Planting Schedule for Two Lots of Trout

Water temperature	Planting, spring 1949		Planting, spring 1950	
	Length (inches)	Age (year class)	Length (inches)	Age (year class)
47° F. (slow growth)	5	1948	7-8	1948
			5	1949
54° F. (rapid growth)	7-8	1948	7-8	1949

Survival in these groups of trout is to be estimated by means of population studies made with the electric shocker and by means of creel census. In the population studies, sampling units consist of sections 330 feet (1/16 mile) long--a total of 80 sections in the 5 miles of experimental area. On the basis of preliminary work in 1949, it would appear that four randomly chosen sections per mile would be an adequate sample. Standards for shocking procedure and estimates of efficiency are based on the 1949 preliminary study, and studies on shocker efficiency as it relates to total population estimation will be continued in the future.

The creel census operates more or less continuously during the early portion of the season when fishing pressure is heavy, thereafter on weekends and holidays and on two weekdays chosen at random. On this stream it is possible to check the total number of anglers, but it is not practicable to check all of them at the end of their effort. To obtain an estimate of the catch and effort after the census-taker's interview, the angler is given a postcard and requested to record the pertinent details at the end of his effort and to return the card. Nearly 50 percent of the anglers cooperate with this request. The data from the completed cards and the interviews are used to estimate the unreported catch of the anglers who do not return cards.

Inasmuch as it is not practicable to weir off the experimental sections, both the creel census and the shocker operations will necessarily have to include the areas above and below in order to evaluate possible movement from the area. Tagging a proportion of the hatchery fish will also serve to supply information on movements as well as to augment population statistics.

A related phase of study conducted at the Cortland Fish Hatchery involves body analysis of the several lots of hatchery fish as well as periodic analyses made from samples recovered after planting. It is hoped that this general problem can be carried into the field and will include analyses of natural fish foods as they relate to conversion and growth in wild and hatchery fish.

FARM FISHPONDS

A program of study on problems of farm fishpond management was initiated in 1949. This work is, in part, supported by a grant-in-aid from the New York State Conservation Council, a state-wide sportsmen's organization. Initial investigations have been concerned with a survey to gain an over-all insight into fish-management problems in New York farm ponds, particularly with regard to the application of the information from the Southeast, and to develop techniques or procedures which may be more applicable in New York.

A bass caught in Missouri had in its stomach a young squirrel about 4 inches long.

STERILIZATION OF A TROUT HATCHERY POND WITH CHLORINE

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THE STERILIZATION of water supplies and ponds with chlorine has been described by Davis (1938, 1946), Connell (1939), Hagen (1940), O'Donnell (1947), and others. A summary of our experiment at the State Trout Hatchery, Decorah, Iowa, may be of value, however, as the experiment deals with the actual mechanics of the sterilizing operation. An outbreak of furunculosis necessitated the sterilization of three raceways and a large clay-bottom pond. Though powdered chlorine compounds are usually most satisfactory for sterilization projects and were used in sterilizing the above-mentioned raceways, liquid chlorine from tanks puts less strain on the budget when large ponds are to be sterilized. It was calculated that the use of liquid chlorine cut the cost of sterilization of the Decorah pond by at least 60 percent, as compared with the cost of powdered chlorine necessary to complete the project.

To insure a complete kill of the disease bacteria, an initial dosage of 200 parts per million of chlorine was used and the concentration was maintained at more than 100 parts per million for more than an hour, as recommended by O'Donnell (1947). The Decorah pond contained 7,242 cubic feet of water, and it was calculated that under ideal conditions the pond would require approximately 91 pounds of chlorine to attain the desired concentration of 200 parts per million. It must be pointed out, however, that any organic matter in the pond (clay bottom included) will remove chlorine from the water; and this, coupled with atmospheric loss, makes it next to impossible to judge accurately the exact amount of chlorine needed for a specific pond. Because of this, it is necessary to have on hand a reserve of chlorine to build up the concentration to the desired amount in case the calculated amount is insufficient. At Decorah, almost 300 pounds were used and at least 100 pounds of this could be classed as "experimental waste."

Preparatory to sterilization, the pond was drained and as much as possible of the organic refuse was removed. The outlet structure was caulked and clay was placed in the well behind the boards to safeguard against any leaks which would allow the highly toxic chlorine solution to escape into an adjacent stream. An additional board on the outlet structure brought the water in the pond above its normal level to insure the sterilization of possibly contaminated marginal banks. The pond was fed by a flume from the initial source of water, and it was necessary to caulk and clay this affluent to prevent the chlorine solution from backing up and entering other ponds in the system--and possibly killing the smallmouth brood stock which were in those ponds at the time.

The drums used for this experiment were of the hundred-pound type and contained liquid chlorine (under pressure) which vaporized to gas upon release. A special technique was required to introduce chlorine from the containers into the water. Experiments with several methods gave the following results:

Common garden hose, attached to the chlorine cylinders, were wired to the drive shafts of outboard motors placed in fixed positions at opposite ends of the pond in a manner similar to that described by Connell (1939). The hose was

extended over the exhaust, however, so that the stream of gas was directed into the propeller wash (figure 1), because it had been found that when the gas was directed into the propeller blades, large amounts of chlorine were forced to the surface and escaped into the atmosphere. Not only was the chlorine lost, but adjacent shrubs and trees were "burnt," and shifting winds kept the operating crew on the move to escape the choking effect of the gas. To safeguard the operators from any serious accident, a gas mask was kept on hand during the actual introduction of the chlorine. Leaking corrections or undue loss from the surface of the pond was detected by pouring common household ammonia on the suspected area, as chlorine and ammonia form a white "smoke" when they are combined.

It was apparent that introduction over an outboard motor was an exceedingly slow process because the amount of gas dissolved in the water by this method was slight. It was so slow, in fact, that nearly as much was being lost to the atmosphere as was being introduced. Time is an important factor, and to bring the concentration of chlorine to 200 parts per million, the method of introduction must be rapid.

To speed up the introduction of chlorine, an ordinary 25-gallon-per-minute water pump was employed. This reduced by 75 percent the time needed to empty a drum. The garden-hose attachment from the chlorine drum was inserted into the 2-inch intake hose on the pump (figure 2), and the flow of chlorine from the drum was adjusted to give the maximum discharge that did not interfere with the siphoning activities of the pump. Further experimentation showed that if the hose from the chlorine cylinder to the suction line of the pump were fitted with thin-walled copper tubing or some similar material, the obstructing of the suction line was minimized. Too high a ratio of gas to water introduced into the pump resulted in loss of prime and the escape of excessive amounts of chlorine gas. The chlorine was thoroughly mixed with the water in both intake and outlet hose as well as in the pump. The outboards were still used, but now they acted mainly as agents of circulation, for the major portion of the chlorine was added to the water by the pump.

As the escaping gas had a chilling effect on the content as well as on the cylinder, the frost line on the side of the drum was used as an indicator of the amount of chlorine remaining. This chilling effect tended to condense the gas in the drum and cause a reduction in flow. It was found that if the cylinders were placed upright in 12 to 18 inches of water, this condensing effect could be minimized. There was danger of freezing the needle valve and shutting off the flow if the gas was allowed to escape too rapidly at the initial opening of the cylinder (Davis 1938). This danger was reduced, however, as the content of the drum approached the half-full mark, at which point the valve could be fully opened.

Though all the equipment yet mentioned is available at most hatcheries, there is one draw-back in that the concentration of the chlorine must be tested repeatedly at intervals of 15 to 30 minutes and at various stations on the pond to insure standard dispersal as well as to insure that the desired concentration is attained and maintained. Mr. R. B. McAllister, District Public Health Engineer of the Iowa Department of Health, obligingly cooperated with both time and equipment in this phase of the experiment. Besides aiding in solving the technical difficulties, Mr. McAllister made dispersal and concentration tests on the water, using a Hellige comparator and orthotolidine as an indicator. If a comparator is not available, the concentration of chlorine can be determined by the use of either the orthotolidine method or "LaMotte" chlorine test papers.

After the desired concentration of 200 parts per million had been reached, all hatchery equipment--nets, tools, and other implements--which came into contact with the infected areas were placed in the pond and allowed to stay there for an hour. The concentration in the pond was held above 100 parts per million for more than an hour and was then left undisturbed until daily checks showed that all the chlorine had escaped from the

Fig. 1

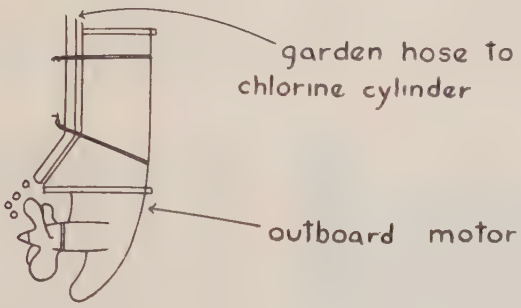


Fig. 2

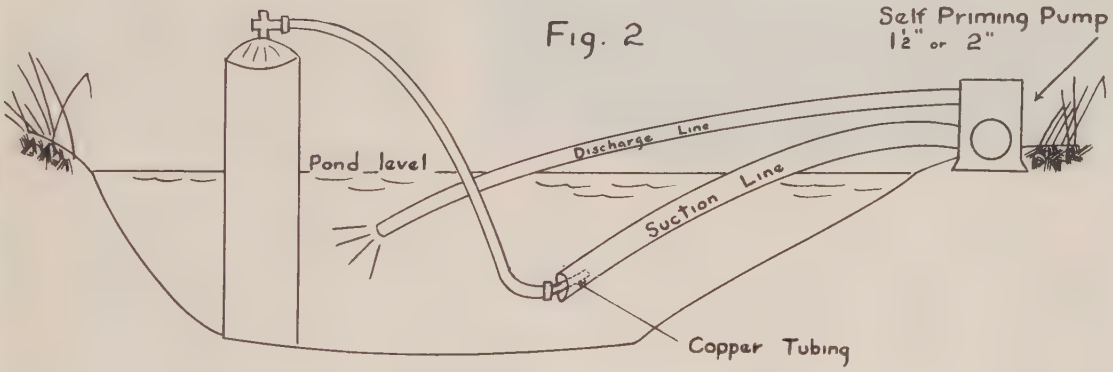
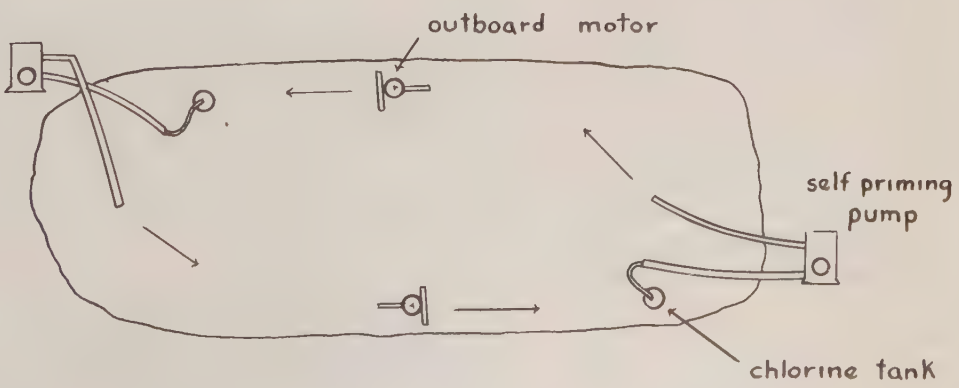


Fig. 3



water. The Decorah pond was free of chlorine the fourth day after sterilization. After the chlorine had been released from the water, the pond was allowed to dry for a week before being refilled and restocked with trout. If a pond must be made available immediately after sterilization, O'Donnell (1947) recommends the use of commercial sodium thiosulphate ("hypo") at the rate of 5.6 grams to each gallon of 200 parts per million of chlorine solution.

Experience gained during this experiment leads us to believe that a seemingly ideal set-up for the sterilization of large ponds with liquid chlorine would entail the use of pumps placed at opposite ends of the pond and outboards situated on the sides and faced in such a manner as to keep the water moving in a circular path (figure 3).

After the sterilizing operation the pumps and the outboards should be flushed with pure water. Care should be taken to see that the residual solution is removed from the machinery, as chlorine has a corrosive effect on some metals.

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The late Dr. Max Planck, one of the most eminent of theoretical physicists, said: "Scientific reasoning does not differ from ordinary everyday thinking in kind, but merely in degree of refinement and accuracy, more or less as the performance of the microscope differs from that of the naked eye. The truth of this statement ... is evident from the very fact that there is only one kind of logic, and, therefore, even scientific logic cannot deduce anything else from given presuppositions than can the ordinary logic of untrained common sense."

All of which means that scientists are no different from the rest of us--only more so--and that every fish-culturist can make sound additions to knowledge by recording facts carefully observed in his work. Even accurate records of production--feeding charts--are subject to scientific analysis, which will yield unsuspected information to advance the science and art of fish culture.

CUTTHROAT TROUT WITHOUT DORSAL FINS

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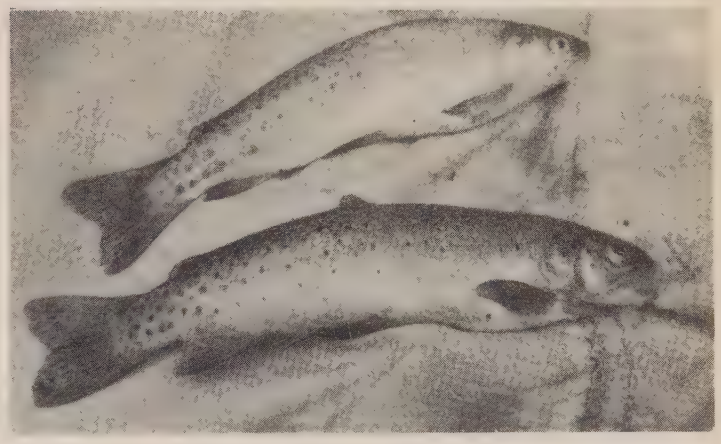
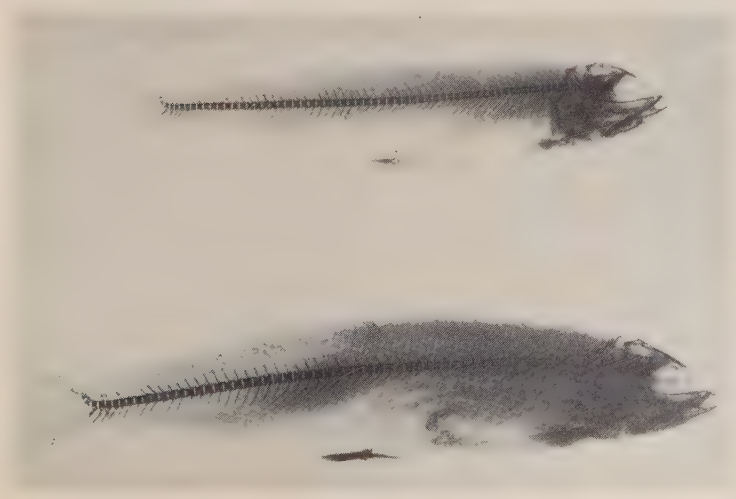
THE DISCOVERY--made several years ago--of a strain of "native" trout (Salmo clarkii) lacking the dorsal fin, has escaped general notice.

These cutthroat trout were first caught by the writer in the South Fork of Sheep Creek on the Ashley National Forest in Utah in 1937. Photographs of these fish were sent to Field and Stream, which acknowledged them in the January 1938 issue. Also, specimens of the smooth-backed trout were forwarded to the American Museum of Natural History, where the associate curator, Dr. E. W. Gudger, reported that they were the only fish lacking dorsal fins ever brought to the attention of the scientific world.



(Photo by Lee Carlson)

The writer made several trips to Sheep Creek in an effort to secure additional specimens for the museum. When his study was interrupted by the war, he was attempting to secure a complete series of these fish. Such a series would have consisted of a specimen lacking any trace of a dorsal fin, other specimens that showed progressive stages of development of the fin, and finally a normal trout. The writer was unable to secure a complete series, however, because the finless fish were becoming increasingly rare and the creek which was their habitat experienced an influx of normal fish, probably from the waters below.



The habitat of the fish was at a very high altitude, which ranged from 10,000 feet down to 9,200 feet above sea level. The coloring of all normal fish caught in the same stream was entirely different from that of these cutthroat trout which either lacked a dorsal fin or possessed a deformed dorsal fin. The finless fish were decidedly darker than the others. This might lead one to believe that none of the strain possessed a normal dorsal fin, although it is by no means conclusive evidence.

The solution to this phenomenon has never been fully elucidated. The possibility that the peculiarity evolved from the isolation of this strain by beaver dams was considered. Careful investigation revealed no marks on these trout nor any other evidence indicating that the dorsal fins had been clipped previously for marking purposes. It was positively established, however, that some of the fish did have a deformed dorsal fin and other fish were completely smooth.

Whether Sheep Creek still contains the unusual strain is not known, as the writer has been unable to return to the stream since his last visit in 1942.

A body of water is much like a livestock range: the number of pounds of living animals which it can support is limited. It is similar to the range in that, if too many animals are present, there will not be enough food, and none of them will thrive. It differs from the range in that, if the number of animals is reduced below what it can support, the gap will soon be made up by an increase in the number and weight of fish, whose growth and reproduction potentialities are immensely greater than those of cattle.

The fish manager suffers one important handicap as compared with his counterpart on the range: he cannot see what is going on. The cattle-grower can use his eyes to determine whether his stock is suffering because there are too many for the food supply; whether other animals of no commercial value to him, such as deer or wild horses, are eating part of the forage which ought to be going into his cows; whether wild animals are preying on his stock; whether disease is starting to spread; whether he has too many old "critters," or too many calves, for proper balance; which animals to dispose of and which to hold. To the fish manager, very little of what goes on under water is visible. He must depend on the analysis of small samples of his stock and of their food supply for the conclusions and decisions which he arrives at. Perhaps even more than a good ranch manager, a good fish manager needs specialized training.

--Brian Curtis, The warm-water game fishes of California: California Fish and Game 35 (4): 270.

A BACTERIAL DISEASE FOUND IN THE BLACK CRAPPIE *POXOMIS NIGRO-MACULATUS*

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THE EXAMINATION of a number of black crappies (Poxomis nigro-maculatus) sent to this laboratory from a lake in Waupaca County, Wisconsin, revealed the presence of a disease which was subsequently found to be bacterial in nature. The black crappie specimens, six in number, were from 7 to 9 inches in length. The specimens examined had been taken from the lake, packed in ice, and shipped immediately to the laboratory.

All the black crappies examined possessed lesions which were quite unlike any others seen thus far. The disease seemed to attack only one body area, that being slightly above and behind the pectoral fin, on only one side of the body. The characteristic appearance of the lesions was that of a swollen, hemorrhagic area measuring about 1 by 1-1/2 inches, the long axis parallel to the longitudinal body line. A layer of very thick, ropy mucoid material covered the actual lesion area. The scales were sloughed off in the affected area, and there was some erosion of the superficial muscle layers.

An examination of the gills and internal organs of the black crappies for gross pathology failed to reveal any significant information. A microscopic examination of the gills, lesion material, and body slime was negative for parasites.

Bacterial cultures were taken from the affected fish by streaking plates of fish infusion agar with material from the lesion mucoid layer, from the superficial lesion layers, and from the affected muscle layers. Deep stab cultures were made in tubes of fish infusion agar. The material for these cultures was obtained from the muscle layers by first searing the area with a hot spatula and then cutting into the muscle with a sterile scalpel.

After incubation for 5 days at 20° C., the plate cultures from the superficial lesion areas were negative for any pathogenic bacteria. A scant amount of growth was seen along the stab line in several of the deep stab cultures. A stained smear of the growth along the stab line revealed a pure culture of a medium-long, motile Gram-negative rod in single and diploid forms, which exhibited marked beading and banding. When grown under anaerobic conditions on fish infusion agar slants at 20° C., this bacterium produced fine, discrete, transparent colonies in a 7- to 10-day incubation period. After a number of serial transplants, the organism could be grown aerobically, but the growth produced was always very scant, even after prolonged incubation.

Biochemically, this bacterium produced acid in maltose, dextrose, and sucrose but failed to attack either lactose or mannite. Nitrate broth was reduced by this bacterium, but it failed to produce indol in peptone broth. A faint line of growth was produced along the stab line in the gelatin stab culture, but the medium was not liquified. Litmus milk remained unchanged by the growth of the bacterium.

A contribution from the laboratory of the Fish Management Division of the Wisconsin Conservation Department.

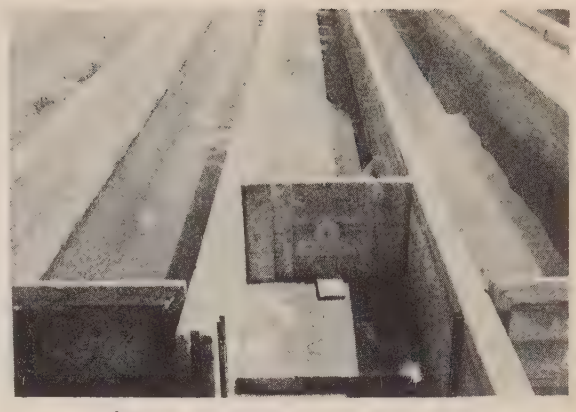
As this disease was noted during the winter, normal black crappie specimens could not be obtained for experimental work. The initial work on experimental reproduction of the disease was done with normal brook trout yearlings. Five brook trout were inoculated intramuscularly with 0.1 cubic centimeter of a broth culture of this bacterium. Within 4 to 7 days, four of the inoculated trout died. The affected trout exhibited swollen areas (measuring about 1 by 1-1/2 inches) at the inoculation sites, which were characterized by an area of pale tissue immediately surrounding the inoculation site and an area of hemorrhage (sometimes spotty) at the lesion periphery. In several of the experimental trout, the lesion broke down, with marked sloughing of the outer tissue layers, leaving an ulcer-type lesion. When the lesion did not break down, removal of the skin from the inoculation site revealed a marked necrosis of the underlying muscle layers. A light-orange exudate, serous in nature, occurred in all the experimental lesions. Direct smears of either this serous exudate or bits of the necrotic tissue revealed the presence of a medium-long Gram-negative rod exhibiting banding and beading by gram stain. Anaerobic cultures of material from the lesions gave a pure growth of fine, discrete, transparent colonies, smears of which showed the typical beaded and banded Gram-negative rod forms.

A series of 15 to 20 carp (4 inches in length) were inoculated intramuscularly with broth cultures of the pathogen. In this species, the inoculation site area showed a moderated reddening, plus some swelling and scale displacement. In the carp, the time of reaction ranged from 1 to 3 weeks, indicating a difference in resistance as compared with the trout reactions. In two of eight inoculated carp, marked necrosis was found in the muscle layers underlying the inoculation site; the other six carp exhibited reactions characterized only by a slight reddening of the underlying tissues. The typical banded bacterium was recovered in pure culture from the lesions in six of the eight inoculated carp. A marked hemorrhagic appearance of the internal organs was noted in the two carp which exhibited necrosis at the inoculation site. Blood serum of several of the carp, taken a week after the appearance of redness at the inoculation site, was capable of agglutinating saline suspensions of the Gram-negative bacterium in dilutions up to 1:80. In several carp there was a progressive reddening and swelling at the inoculation sites, but this finally subsided completely, leaving the carp apparently unaffected. Two weeks after the inoculation, serum from the carp that showed the subsiding of symptoms agglutinated the specific bacterium in dilutions up to 1:80.

A later series of inoculations into normal black crappies produced swelling and scale displacement. The specific bacterium was recovered in pure culture from the experimentally produced lesions.

The biochemical reactions, plus the morphology of the Gram-negative rod isolated from the black crappie disease, would tentatively place this pathogen in the family Spherophoraceae, genus Spherocillus.

The tench was formerly applied to the hands or feet of any individual suffering from fever, jaundice, headache, or toothache.



(Photos and drawing courtesy of author)

AN EXPANSION RACEWAY GATE

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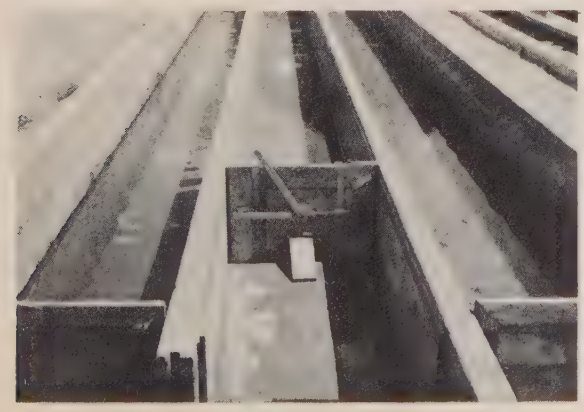
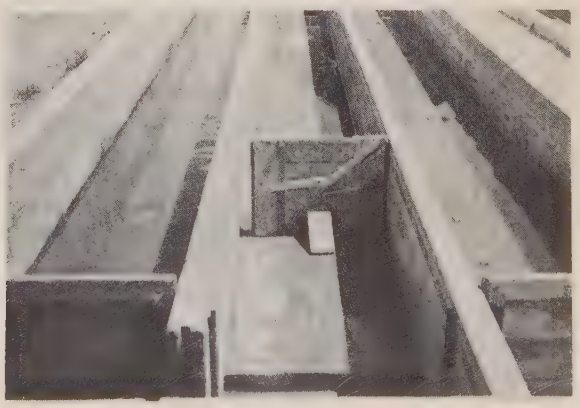
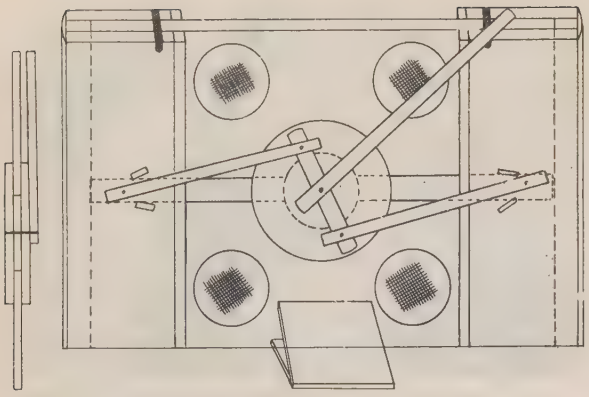
Wyoming Game and Fish Commission
Rock River, Wyoming

NO CLAIMS to originality are made for the expansion raceway gate herein described. This was, however, developed at the Como Bluff Fish Hatchery, where the need for just such a tool had often been experienced. The original intention was to produce a rough model to test the general idea of construction. Fortunately, or perhaps unfortunately, the model turned out to be so effective that it was immediately pressed into service: as usual, further development awaits one of those leisure moments that a fish-culturist seeks but seldom finds. Because the design proved highly workable and had not been seen previously, it was considered worthy of passing on for what others could make of it.

The expansion gate sees almost daily use in our hatchery routine. This gate is especially well suited for crowding fish to one end of a raceway during cleaning or sorting operations. A watertight gate of similar construction is equally valuable during various treatments in which it is desired to decrease the volume of the raceway. In addition, a miniature model of the gate is extremely useful in handling the smaller hatchery troughs. Its most salient features include its







easy expansion to fit raceways of different sizes and the fact that, once placed, it remains firmly in position but nevertheless is very easily removed.

Apologies are in order for the illustrations, as they show the original model with little improvement. It is hoped, however, that they will supply other builders with any necessary details which may be missing from the diagram. Dimensions are not included, as the gate should be constructed to fit the general dimensions of the raceways in which it will be used.

The ends of the gate are padded with rubber or burlap to provide a better fit against the sides of the raceway. The degree of expansion is determined by the size of the wheel to which the lever arms are attached. For smoother operation, an arrangement of three wheels is utilized, a central bar extending to each expansion board. This central bar runs in a slot, as shown, and serves to keep the expansion boards in a vertical position. The gate is held in the expanded position by securing the lever arm at the top of the gate. In the model this was done by placing a pin in the drilled headpiece behind the lever, but any series of notches would serve the same purpose.

Nobody has struck oil yet in North Dakota, but a seismograph crew brought in a piscatorial gusher near Garrison early in December.

While mapping underground rock formations to find oil traps, the crew drilled a hole about 12 miles east of Garrison. The strong flow of water disgorged from this hole contained hundreds of small fish--catfish, pike, and river minnows, from 1-1/2 to 3 inches in length. The drillers may have hit an underground stream which connects with Crooked Lake fish refuge, about 7 miles away.

No life, my honest scholar, no life so happy and so pleasant, as the life of a well-governed angler; ... God never did make a more calm, quiet, innocent recreation than angling.--Izaak Walton.

A GRAPHIC RECORD FOR HATCHERIES REARING ARTIFICIALLY FED FISH

Maurice Bryant, Jr.
North Carolina Wildlife Resources Commission
Marion, North Carolina

FOR ONE or more reasons, all fish-cultural stations keep a record of their fish production. Methods and forms of recording the many useful statistics differ widely, but too many of these reports are quite lengthy and often rather complicated. After poring over several files and many sheets of paper (no matter how carefully filed), most fish-culturists have wished for a simpler arrangement--one that would put the work of several years on a few sheets of paper, readily available for inspection.

A graph or chart covering the work on each species during one or more years may be the answer. A graph gives a better picture of the work than columns of figures on many sheets of paper. So that trends can be followed more easily, it is advisable to use lines of a different color for each factor studied.

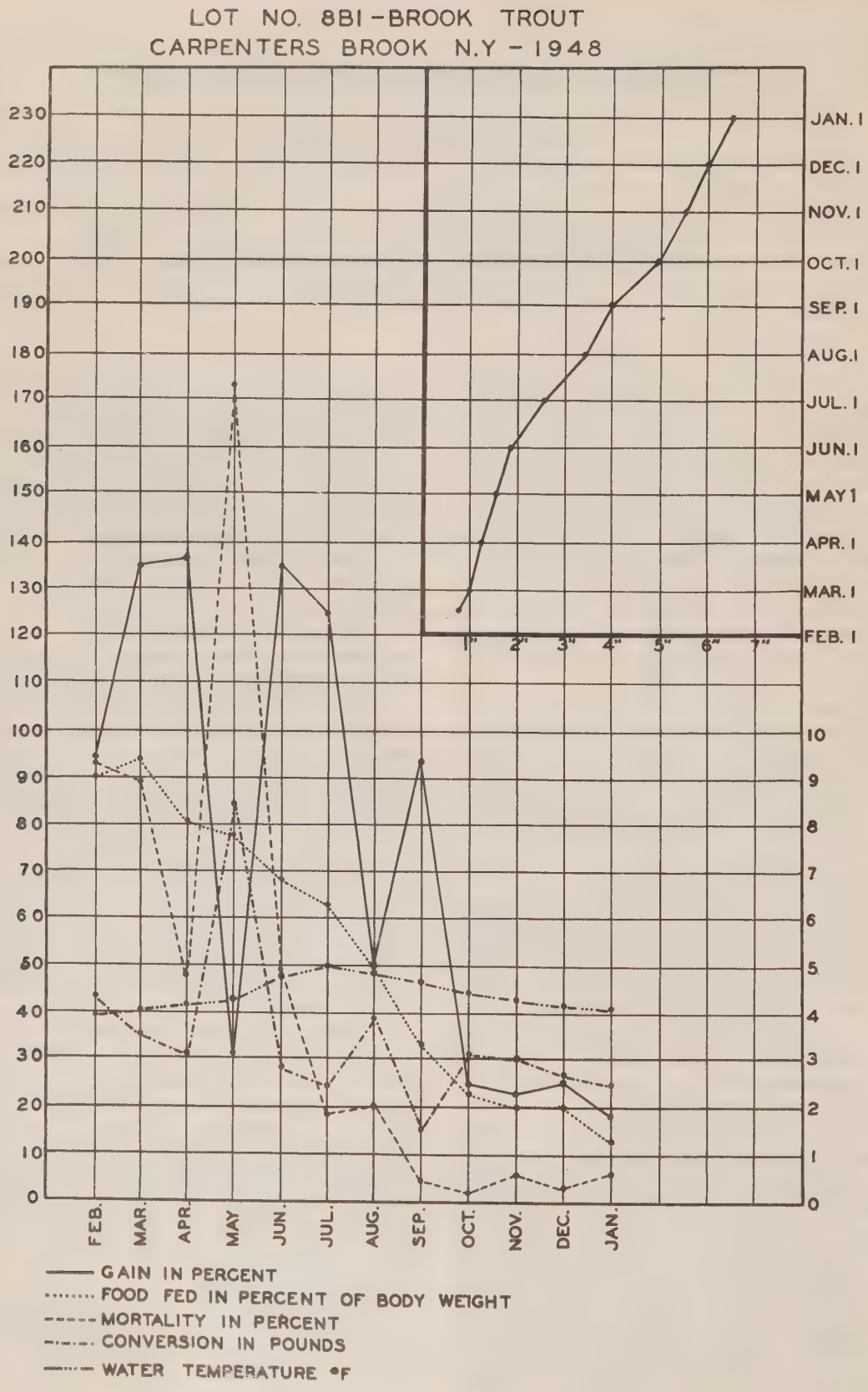
One of the main objectives of such a graph would be to establish average curves for the various factors that affect fish production. Once average curves have been established for a particular station, any deviation or break is obvious at a glance--and if the break is undesirable, measures may be undertaken to re-establish the proper curve.

Often, under most systems now in use, trends and recurring instances are not noted until too late. In a simple graph presenting a definite picture, trends are more readily noticeable. For example, high mortality from a particular disease may occur at about the same time each year. On large stations, especially where several species are reared, this fact may be overlooked in the shuffle for several years. If, however, graphs are kept up to date and are displayed on the office or hatchery wall, along with the average curves for perhaps a 5-year period, these instances of recurring high mortality really stand out and almost force themselves on the attention of the fish-culturist. Where it is known that an outbreak of a particular disease at a definite time of year is highly probable, it may be possible to take preventive measures before the damage is done--and thus it may be possible to save many fish as well as much labor.

The accompanying graph covers one lot of brook trout reared at the Carpenters Brook Station of the U. S. Fish and Wildlife Service at Elbridge, New York, during the 12-month period from February 15, 1948 (the time of first feeding), through January 1949. Water temperature, amount of food fed in percent of body weight, gain in weight of fish, mortality, and food conversion are recorded at monthly intervals. The size of the fish from month to month is shown in one corner of the graph.

There are two major breaks to be noted in what should have been a fairly even curve. The first break, in May, was directly traceable to an outbreak of bacterial or eastern gill disease. This was finally checked through the use of pyridyl mercuric acetate but only after a very high loss and a proportionate drop in the percent gain for the month. This also showed an appreciable rise in the conversion factor.

The second break, which occurred during August, showed another drop in percent gain and some rise in conversion but only a very slight rise in mortality. This


LOT NO. 8BI - BROOK TROUT
CARPENTERS BROOK N.Y - 1948
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
JAN. 1
DEC. 1
NOV. 1
OCT. 1
SEP. 1
AUG. 1
JUL. 1
JUN. 1
MAY 1
APR. 1
MAR. 1
FEB. 1
1"
2"
3"
4"
5"
6"
7"
10
9
8
7
6
5
4
3
2
1
0
FEB.
MAR.
APR.
MAY
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
JAN.
GAIN IN PERCENT
FOOD FED IN PERCENT OF BODY WEIGHT
MORTALITY IN PERCENT
CONVERSION IN POUNDS
WATER TEMPERATURE °F

break was traced to error in making sample counts. At that time, the break was thought to be a normal slowing of growth, the result of a slight drop in water temperature coupled with a slower growth rate because of increased fish size. The following month, however, the entire lot was inventoried for numbers and total weight; and these new figures offset those of the previous month, showing a higher percent gain and lower conversion than should have been expected.

These are but two instances of what this type of chart can show. If the break noted in May 1948 should continue to occur each year at about the same time, preventive treatments started the latter part of April might keep the loss from infection at a minimum, resulting in a saving of many fish, much labor, and larger fish at the end of the year. The other break, which is more or less mechanical in kind, might well be eliminated, particularly after a few years have permitted the establishment of an average curve for the station. In such a situation, the sampling error should be suspected immediately and new samples or a complete inventory taken of the lot before the passage of too long a period.

The temperature curve usually is not too variable but is included as an indicator, this item being one of the main factors controlling growth rate and the amount of food to be fed.

On this particular chart there is no major break in the curve representing the amount of food fed in percent of body weight, but such a break has been noted on other charts. It may be found possible to vary for a given period the amount of food fed in percent, in order to get added growth at a slight sacrifice in conversion; or it may prove to be desirable to sacrifice growth for better conversion--whichever seems to be the most economical to suit local conditions.

The main purpose of the graph is to bring to the fish-culturist's attention, as soon as possible, any deviation from the normal progress of the fish and to provide a handy, compact set of records.

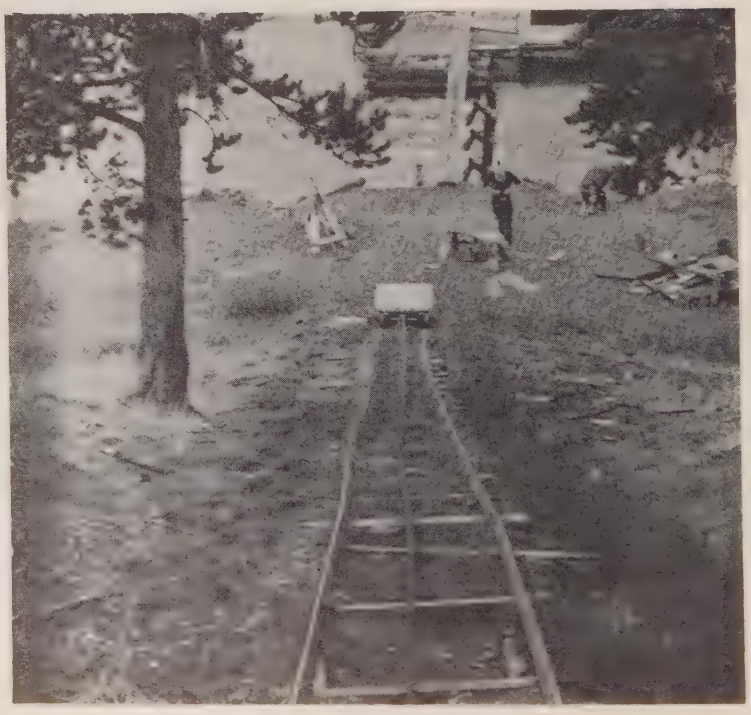
Such a graph has been used for 2 years and has been of great help in the work. Obviously, however, the longer these records are kept, the more useful they become--as in the case of the management charts now in use in many hatcheries. It might be advisable to make up graphs of the past 5 years' work at those hatcheries where management charts have been kept. The time used in doing this will be well spent.

The sucker-trout controversy remains unsettled. Some biologists claim that the sucker minnow is the born foe of trout. According to this school of thought, the sucker not only takes the food needed to maintain at a high level the supply of the game fish, but also eats the trout eggs. Other biologists argue that the sucker, itself a major item in the diet of big rainbows and browns, eats vegetable matter and other food scorned by trout--and any waste spawn that have washed away from the trout nest. Stream-study crews of the Michigan Institute for Fisheries are looking for the answer.

Pelican Creek, Yellowstone National Park, Wyoming.

The trap for spawning trout and a hillside railway.

The eggs are put into small barrels, pulled up the hillside railway, and taken by truck to the fish-cultural station in the Park.



COMMENTS

Oregon State Game Commission
1634 S. W. Alder Street
Portland 8, Oregon

November 7, 1949

The Editor
THE PROGRESSIVE FISH-CULTURIST
Fish and Wildlife Service
Interior Building
Washington 25, D. C.

Dear Sir:

Fish-culturists, particularly in the West, may be defeating their expressed purpose by developing strains of fish which produce eggs at 2 years of age. Such selection is designed for the early production of eggs in hatcheries in order to avoid the added costs of feeding the fish for 1 or 2 additional years, as would be necessary for fish that matured at 3 or 4 years of age. The probable effect of such a policy upon the planted progeny of early maturing fish has been totally disregarded.

In eastern waters the fish reared from early maturing stock are generally planted as legal fish and, more often than not, are taken by anglers before reaching maturity. In New Jersey, for example, where the Hackettstown strain of brood stock was developed, the planting of fish is "for the rod" and fish which survive from one season to the next are rare indeed. Hence, the problem is not acute there.

In the West, however, much of the brook trout production from hatcheries is destined for planting in lakes, which are not always richly supplied with food. When fish planted in poor lakes reach maturity, growth is sharply arrested. In rich lakes, of course, the fish may continue to grow in spite of maturation.

The rainbow trout is at present the subject of selection experiments aimed at early maturation, and at least three western states have strains of fish which spawn when they are 2 years old. The rainbow seems to reflect conditions within its environment after reaching the spawning age more readily than the brook trout, and in many lakes the curtailed growth after spawning is the result of a physiological drain upon the growth processes of the trout--as reflected in its inability to gain back the weight lost during spawning, consequent failure to add a yearly increment of growth, and the added drain resulting from the development of the sex elements for the following spawning season. Some of the attributes associated with immaturity are rapid and sustained growth, generally superior table quality, and nicer appearance.

With the stocking of trout which exhibit early maturity, the fish-culturist may be placing on the fish a handicap which, more often than not, will be reflected in a diminution of length at maturity and a curtailed growth after maturity if the fish and their progeny continue to spawn at an early age.

Sincerely yours,

/s/
H. J. Rayner
Chief of Operations
Division of Fisheries

helpful--

Freemont, Ohio
February 1, 1950

THE PROGRESSIVE FISH-CULTURIST
Washington, D. C.

Gentlemen:

Subject: Selective Breeding

Selective breeding has given us all sorts of dogs, cattle, corn, and other domestic plants and animals. It has given us all kinds of aquarium fish. But hatcheries haven't done much yet to improve the game fish. You might be interested in a few of our selective breeding projects.

In our hatchery we subject all our fish to a shock test. When we give them a shock, those which move the fastest are kept for brood stock. The point is that we want fish which will really take off when they are hooked.

The fish which pass the shock test are then tested for intelligence. They are placed in a complicated maze. Interestingly enough, those which can find their way out easily aren't kept--like you might expect. We kill them at once. The fish which are so ignorant that they can't begin to find their way out are the ones we use for brood fish. Fish are now so educated that they are influenced by the sun, the moon, the barometer, the temperature, the wind direction, and other things. If we can raise a more ignorant strain, the fishermen will be able to catch more of them.

Then we subject the fish which have passed the first two tests to still another test. This is called our "taste for the exotic" test. For this test we pull a pancake-turner with a miniature grist mill on it through the pond. Any fish which follow it are kept for brood stock. The point is that many of the lures made now are so exotic that we will need to breed special strains of fish which will bite on them. We learned accidentally that there are some things which fish can't be trained to show interest in. A gust of wind swished a modern kind of hat from a woman's head and it landed in one corner of our biggest pond. All the fish immediately beat it for the opposite corner. They wouldn't leave it until we removed the hat. This shows that any plug patterned after one of these present-day hats simply will not take game fish.

As a result of these selective tests, we now hope to raise only fish which are fast, ignorant, and interested in exotic things.

We worked for years on a very important selective-breeding study but finally gave up the idea, so we may as well tell you about it. We tried to raise strains of bass and trout which would bite only for Democrats, or only for Republicans. If that could be done, the hatcheryman would soon become an important political figure: he might even realize his childhood ambition to live in the White House. We gave up the study because so many people now are independent voters that we can't find enough people with a pure one-party background to help train the fish.

Yours truly,

"Doc"

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Stuttgart, Arkansas

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Westlake, E. F., Jr.--Continued
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Measure the amount of food produced in a trout stream in a year, how many trout fry are produced, how much of the food is consumed by the trout population, what the mortality rate is among the trout, what proportion of the fry reach a takeable size and how many of them are actually caught by anglers. It sounds difficult and is difficult, but it has been done in New Zealand and, so far as the writer can learn, in no other country.

--D. F. Hobbs, Harvesting seas and rivers: Public Service Journal, August 1948.

The Missouri Conservationist (November 1949) reports that a sign posted in that State reads:

> Since man is animal and savage from birth, we'll never improve our condition until we have posted a warning on earth. No hunting, No shooting, No fishing, No trespassing, KEEP OUT.

REPRINT

A METHOD OF MEASURING FISH EGGS

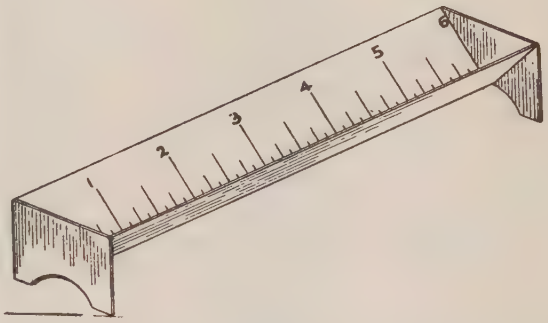
H. von Bayer, C. E.
Architect and Engineer, United States Bureau of Fisheries

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

IN A well-regulated fish hatchery it becomes at times necessary to count the eggs of fishes, so as to know the quantity on hand and prepare for certain shipments of eggs as well as for the future care of the fry. The methods thus far employed have been to determine by actual count the number of eggs contained in one liquid quart measure, and then to multiply said number by the number of quarts of eggs on hand; or to weigh one liquid quart of counted eggs, next to weigh all the eggs on hand, and then by simple proportion to determine the number of all the eggs.

The new method proposed by the writer is first to determine the diameter* of one egg, and then to enter with the value of said diameter a table or diagram in which the corresponding number of eggs per liquid quart or other unit measure is found by inspection.

To determine the diameter of one egg of a certain species of fish, a V-shaped metal trough with scale engraved thereon is used, in which a certain number of eggs is placed one egg deep in a row, the eggs touching each other; the space occupied by the eggs is then read on the scale; this reading, when divided by the number of eggs in the trough, will give the diameter of one egg.



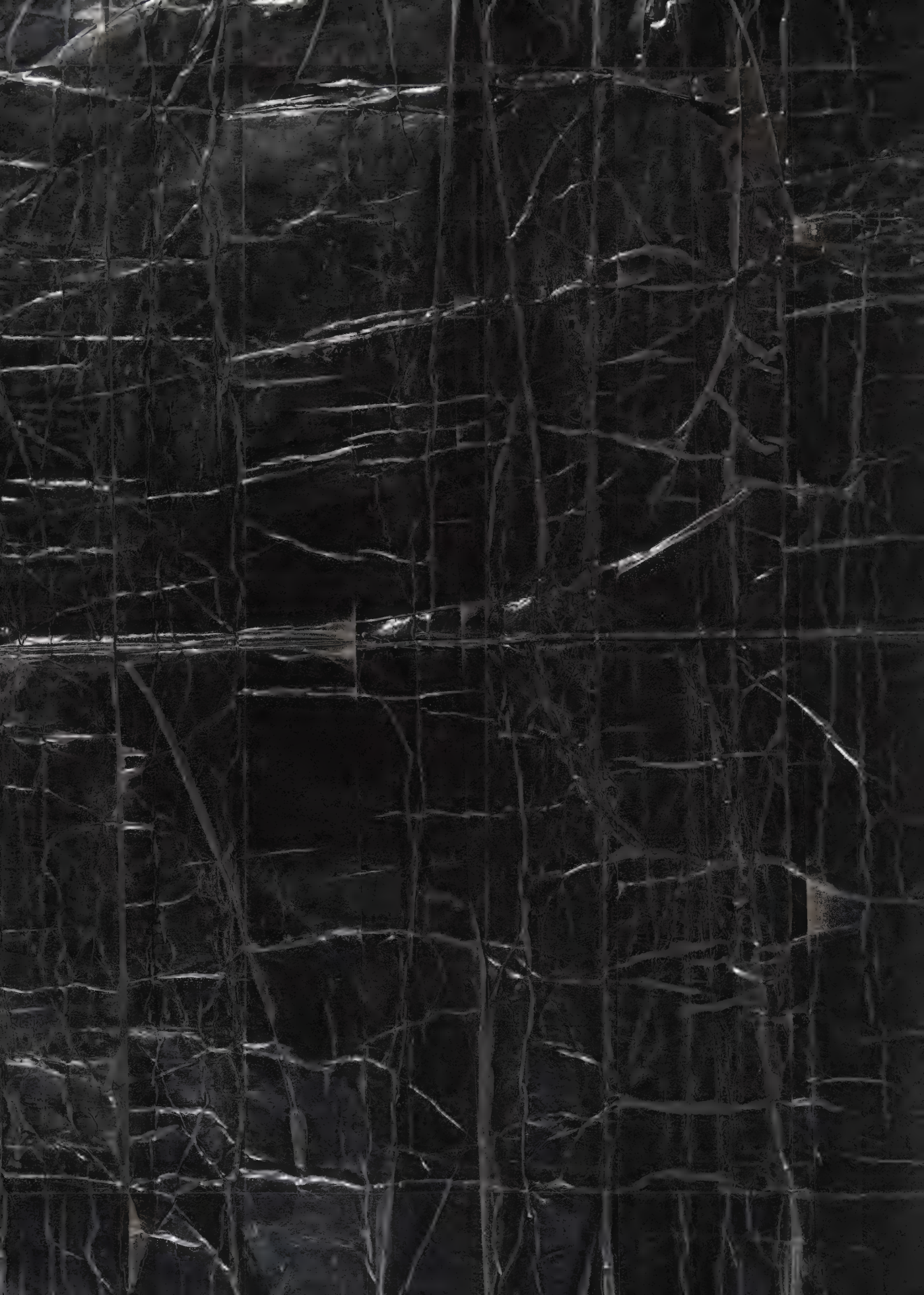
Metal trough for use in determining diameter of fish eggs.

The accompanying table and diagram [see note] are self-explaining. They are based on a series of actual counts of eggs contained in a liquid quart measure, these counts fairly agreeing with each other and the theoretical value, and being extended by computation according to the law that solids increase as the third power of their diameters.

*By diameter is here understood the diameter of the egg including its surrounding matrix, if any.

Reprinted from Bulletin of the Bureau of Fisheries 28 (pt. 2, 1908): 1011-1014. Government Printing Office, 1910. Also, Document No. 703, issued April 1910.

This diagram, believed less helpful than the table, has not been reprinted here.--The EDITORS.



(This reproduction of the table may be removed from the issue.)

TABLE FOR FINDING NUMBER OF FISH EGGS OF GIVEN DIAMETER PER LIQUID QUART.

Diameter.	Number.	Diameter.	Number.	Diameter.	Number.	Diameter.	Number.
Inch.		*Inch.*		*Inch.*		*Inch.*	
0.300	2,506	0.230	5,562	0.160	16,521	0.090	92,826
	2,531		5,635		16,835		95,990
	2,557		5,709		17,157		99,297
	2,583		5,785		17,487		102,762
	2,609		5,862		17,825		106,390
0.295	2,636	0.225	5,941	0.155	18,172	0.085	110,190
	2,663		6,021		18,528		114,172
	2,690		6,102		18,894		118,346
	2,718		6,185		19,270		122,730
	2,746		6,269	0.151	19,655		127,333
0.290	2,775	0.220	6,355	0.150	20,050	0.080	132,170
	2,804		6,442		20,456		137,251
	2,833		6,531		20,874		142,600
	2,863		6,622		21,303		148,220
	2,893		6,715		21,744		154,155
0.285	2,923	0.215	6,809	0.145	22,197	0.075	160,400
	2,954		6,905		22,662		166,995
	2,985		7,002		23,140		173,950
	3,017		7,102		23,633		181,300
	3,050		7,204		24,140		189,070
0.280	3,083	0.210	7,307	0.140	24,661	0.070	197,290
	3,116		7,412		25,197		205,992
	3,150		7,520		25,748		215,204
	3,184		7,629		26,316		224,995
	3,219		7,741		26,901		235,377
0.275	3,254	0.205	7,855	0.135	27,504	0.065	246,410
	3,290		7,971		28,125		258,141
	3,326		8,089		28,764		270,631
	3,363		8,210		29,422		283,936
	3,400	0.201	8,333		30,101		298,132
0.270	3,438	0.200	8,459	0.130	30,801	0.060	313,289
	3,476		8,587		31,523		329,490
	3,515		8,717		32,268		346,828
	3,555		8,851		33,036		365,405
	3,595		8,987		33,829		385,331
0.265	3,636	0.195	9,126	0.125	34,647	0.055	406,733
	3,677		9,268		35,492		429,750
	3,719		9,413		36,364		454,539
	3,762		9,561		37,265		481,270
	3,806		9,712		38,198		510,139
0.260	3,850	0.190	9,866	0.120	39,161	0.050	541,362
	3,895		10,023		40,156		575,173
	3,940		10,184		41,186		611,893
	3,986		10,348		42,251		651,776
	4,033		10,516		43,354		695,223
0.255	4,081	0.185	10,688	0.115	44,494	0.045	742,613
	4,129		10,863		45,676		794,400
	4,178		11,042		46,899		851,128
	4,228		11,225		48,166		913,380
0.251	4,279		11,412		49,480		981,852
0.250	4,331	0.180	11,603	0.110	50,841	0.040	1,057,350
	4,383		11,799		52,254		1,140,780
	4,436		11,999		53,720		1,233,250
	4,490		12,203		55,239		1,335,960
	4,545		12,412		56,817		1,450,406
0.245	4,601	0.175	12,627	0.105	58,456	0.035	1,578,320
	4,658		12,846		60,159		1,721,630
	4,716		13,069		61,925		1,883,020
	4,776		13,298		63,766		2,065,130
	4,835		13,533	0.101	65,680		2,271,500
0.240	4,895	0.170	13,774	0.100	67,670	0.030	2,506,310
	4,956		14,020		69,741		
	5,019		14,272		71,899		
	5,083		14,529		74,146		
	5,148		14,793		76,486		
0.235	5,214	0.165	15,064	0.095	78,927		
	5,281		15,341		81,473		
	5,350		15,625		84,130		
	5,419		15,916		86,904		
	5,490		16,215		89,800		

CONVERSION TABLE.

1 inch = 25.4 millimeters.
1 millimeter = 0.03937 inch.
1 quart = 57.75 cubic inches.
1 quart = 0.9464 liter.
1 liter = 61.0234 cubic inches.

1 liter = 1.0567 quarts.
1 pound = 0.4536 kilogram.
1 kilogram = 2.2046 pounds.
Fahrenheit = 9/5 centigrade + 32°.
Centigrade = 5/9 Fahrenheit − 32°.

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1 kilogram = 2.2046 pounds.
Fahrenheit = 9/5 centigrade + 32°.
Centigrade = 5/9 Fahrenheit + 32°.

Example:

d = 0.127", diameter of whitefish egg (determined).
n = 33,036, number of whitefish eggs per quart (actually counted).
d_1 = 0.1406", diameter of shad egg (determined).
n_1 = Number of shad eggs per quart (sought).

$d^3 : d_1^3 = n_1 : n$

$\therefore n_1 = \frac{d^3 n}{d_1^3}$, or

$0.127^3 : 0.1406^3 = n_1 : 33,036$

$n_1 = \frac{0.127^3 \times 33,036}{0.1406^3} = 24,345$, answer.

REVIEW

THE LIFE STORY OF THE FISH: HIS MORALS AND MANNERS

by Brian Curtis

Harcourt, Brace and Company, New York, 1949. 284 pages, illustrated. $3.75.

When The Life Story of the Fish appeared in 1938, I took unusual pleasure in reviewing the book and recommended it whole-heartedly to every fish-culturist and conservationist.

Because of the advance in piscatorial knowledge during the past 10 years, this book has been rewritten with extensive revisions and additions. One entirely new chapter and a brief and somewhat inadequate list of references for those who wish to consult source material, have been added. In reworking the material and adding accumulated knowledge, however, the freshness, the humor, the entertaining style, and the judicious balancing of the subject matter have not been injured in the slightest and no tiresome detail has been added. Some parts seem condensed, but no scientific accuracy has been lost and, above all, the soundness of the point of view has not been impaired.

The new chapter, "Fish and Fishermen," dealing with man's major interests in fish--food and sport--is a distinct addition and an improvement over the first edition. It presents in 24 brief pages a balanced and thoughtful statement covering the field of fishery conservation. A single quotation (pages 244-245) will illustrate the serious purpose and judgment which characterize Curtis' work:

> "The present-day thinking of trout culturists and conservationists may be summarized along these lines:
>
> "1. Brood stocks, hatchery-reared and maintained, should be the main sources of egg supply. Eggs should be taken from wild fish only where facilities are inadequate for them to spawn naturally.
>
> "2. The most economical method of stocking heavily fished waters

is with catchable-sized fish planted just before and during the season. Fingerlings are more economical for lightly fished waters.

"3. The old type, cold spring hatcheries must be retired just as rapidly as sources of water can be obtained suitable for producing catchable fish--retaining enough of the old hatcheries to meet fingerling needs.

"4. Effective disease-control measures, low-cost foods, and means of reducing expenditures on apparatus and installations must be constantly sought in order to raise more catchable fish with the money available.

"5. Unceasing vigilance and constant effort are needed in order to use every reasonable means to preserve trout waters against the demands of dam-builders, lumbermen, road-builders, farmers, and miners; otherwise we shall find ourselves with hatcheries full of trout and no water to put them in.

"6. Wild trout must receive all possible protection through improvement of their habitat and through wise conservation regulations. It still remains true that they can produce more, better, and cheaper little trout than man is able to do."

If you have never read a book before, you will thoroughly enjoy reading The Life Story of the Fish. If you have read whole libraries of books on ichthyology, its perusal will still be a most satisfying experience.

Elmer Higgins.

NORTH AMERICAN FRESH WATER SPORT FISH

by Lou S. Caine

A. S. Barnes and Company, New York, 1949. 212 pages, illustrated. $5.00.

Wisely avoiding the many differences of opinion as to just what distinguishes a game fish from a nongame fish, Caine has undertaken a comprehensive survey of sport fish--"any fish that is fished for with hook and line and caught for sport or pleasure, regardless of its edible or game qualities"--in the fresh waters of this continent.

This volume has been designed primarily for the practical angler, but the lucid style and nontechnical language impart a great deal of accurate ichthyological information. The opening chapter, "Fish Facts for Fishermen," is a summary of current information on color vision in fishes, their coloration, effect of water temperatures, effect of water plants, natural enemies, grubs, basic fish anatomy, and fish management and conservation. The major portion of the volume is a very attractive discussion of the various species of fresh-water fish that furnish some degree of piscatorial pleasure. Appearance, structure, tastes, habits, and habitat are described from the viewpoint of the fisherman--but on the basis of careful ichthyological research as well as of "hand-to-fin" experience. Aside from the color plates and photographs, line drawings emphasize the outstanding characteristics of each species. The applicability of this book as an encyclopedia for fresh-water fishermen is enhanced by the fact that the author, although he has listed the fish by family--

sunfish, salmon and trout, grayling, pike, perch, bass, bowfin, drum, catfish, minnow, sucker, and whitefish--under their most widely accepted common names, has also included and cross-indexed the various names by which they are known in different sections of the country.

The information in regard to rods, reels, lines, lures, and leaders is as comprehensive as might be expected from one in Caine's position as director of research for one of America's largest manufacturers of fishing tackle.

"Methods of Fishing," a chapter of advice and admonition from a man who is recognized as a top-flight fisherman, has a truly authoritative ring.

CLEARING HOUSE

Construction of farm fish ponds.
J. M. Lawrence.
Circular 95, 55 pp., illus.
June 1949.
(Alabama Polytechnic Institute, Agricultural Experiment Station, Auburn, Alabama.)

Small fish pond problem-management chart for West Virginia.
E. A. Seaman.
Tech. Pub. 2. December 1949.
(Conservation Commission of West Virginia, Division of Fish Management, Charleston, West Virginia.)

Analysis of the bottom fauna production in fertilized and unfertilized ponds and its utilization by young-of-the-year fish.
Mercer H. Patriarche and Robert C. Ball.
Tech. Bull. 207, 35 pp. May 1949.
(Michigan State College, Agricultural Experiment Station, East Lansing, Michigan.)

MAILING LIST

Applications for THE PROGRESSIVE FISH-CULTURIST, which is distributed free of charge on a regular mailing list, should be directed to the Editor, PROGRESSIVE FISH-CULTURIST, Fish and Wildlife Service, Interior Building, Washington 25, D. C.

It is the aim of the Fish and Wildlife Service to maintain an up-to-date mailing list for THE PROGRESSIVE FISH-CULTURIST and to record promptly requests for change of address. Owing to the method of filing address cards and maintaining the addressograph plates, it is important that anyone requesting a change of address notify this office of both the old and the new address.